THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK JANUARY, 1907

The Heating and Ventilation of the Cleveland Hippodrome

An Interesting Type of Downward Ventilation With an Auxiliary System of Direct Steam Heating

The new Cleveland Hippodrome, in Cleveland, Ohio, is a fine type of a modern office building and theater combined. The theater, which is one of the largest in the country, occupies the central portion of the building, while on each side rise two wings containing offices, one eleven stories high and the other seven stories high.

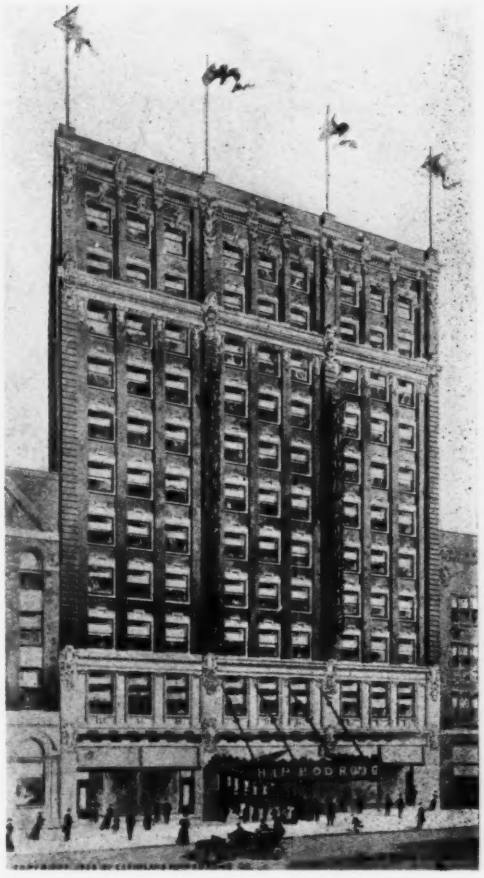
The Hippodrome is located in the heart of Cleveland, extending from Euclid avenue to Prospect avenue. It is constructed of steel, reinforced with concrete and is fireproof. The building has its own electric lighting plant, sprinkling system, hot and cold water, steam heat and mechanical ventilating system.

The power equipment, including boilers, stokers, engines, generators, etc., are located in the basement of the right wing. The two wings, which are devoted to offices and stores, are heated by direct radiation. In the auditorium, however, there is, in addition to the supply of direct radiation, a noteworthy down draft system of ventilation.

A rathskeller, located in the basement, is also ventilated by a down draft system, effected by means of a pressure fan and aspirating vacuum system. The ventilation of the stage and basement under the stage was accomplished by a vacuum system.

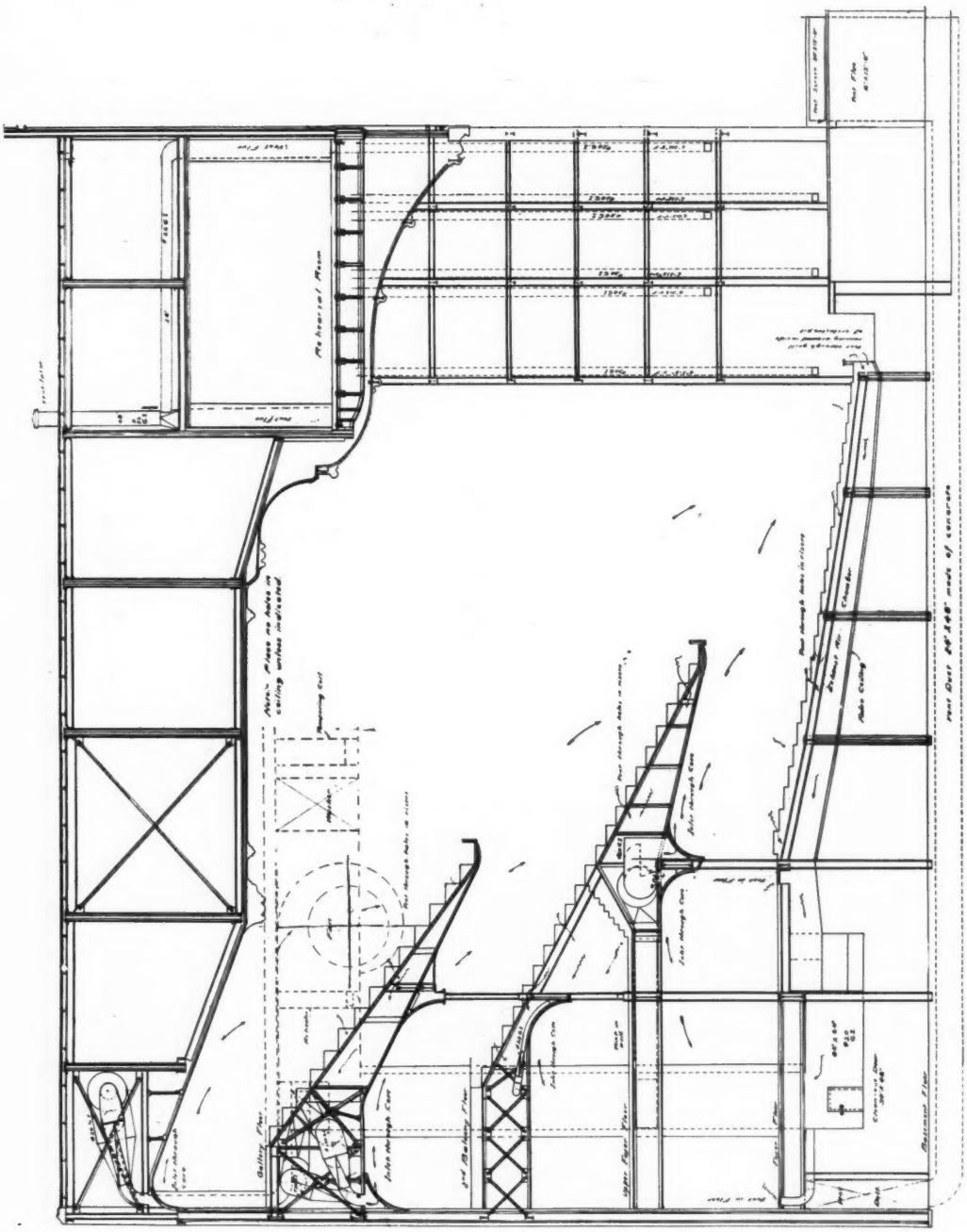
VENTILATION OF THE AUDITORIUM

Two fan rooms connecting with the auditorium are located on the fourth floor of the office building, one on each side of the auditorium wall. Each room contains a steel plate fan, three-quarter housed, capable of delivering 60,000 cubic feet of air per minute under a pressure of 5/8 ounce per



Copyright 1906 by Cleveland Hippodrome Co.

THE EUCLID AVENUE WING OF THE NEW CLEVELAND HIPPODROME BUILDING

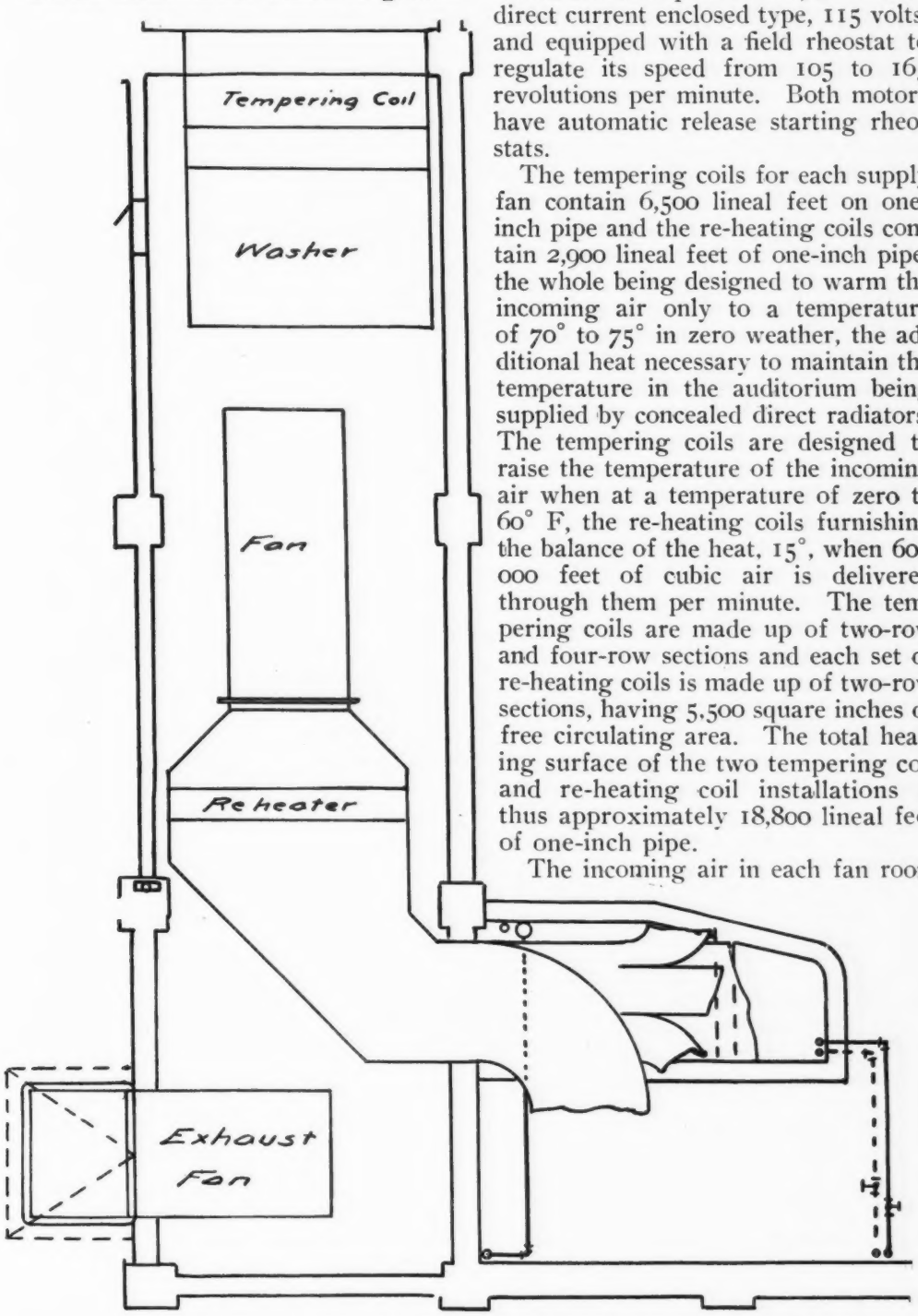


SECTION THROUGH AUDITORIUM OF CLEVELAND HIPPODROME, SHOWING SCHEME OF VENTILATION

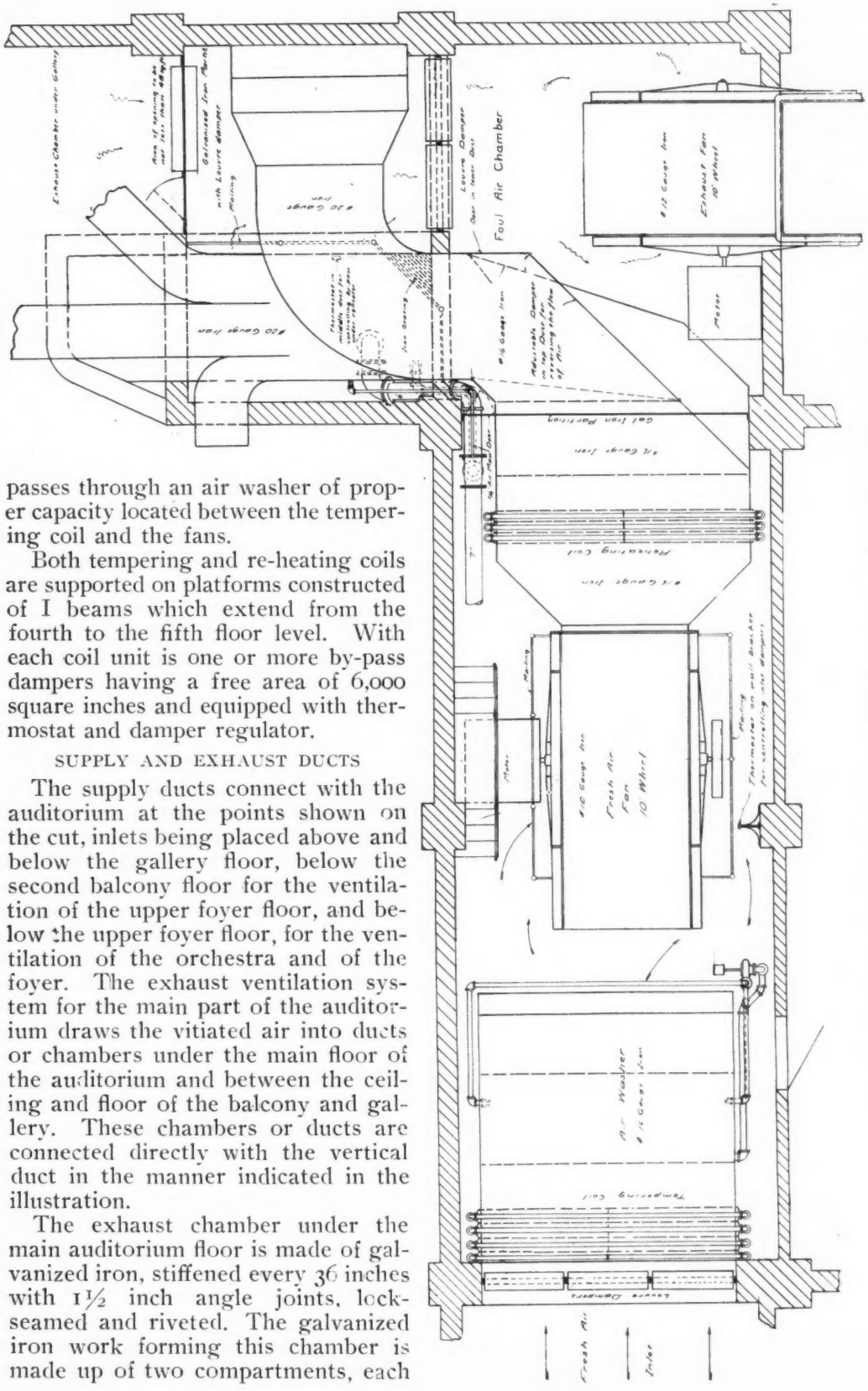
square inch at 135 revolutions per minute; also one steel plate ventilating wheel, capable of exhausting the same quantity of air with free discharge at the same speed. The space available did not admit of fan wheels of greater diameter than 10 feet. Each supply fan is furnished with a direct current enclosed type, 115 volts, 135 revolutions, constant speed motor, while the ventilating wheels are each furnished with a variable speed motor, also of the direct current enclosed type, 115 volts, and equipped with a field rheostat to regulate its speed from 105 to 165 revolutions per minute. Both motors have automatic release starting rheostats.

The tempering coils for each supply fan contain 6,500 lineal feet on one-inch pipe and the re-heating coils contain 2,900 lineal feet of one-inch pipe, the whole being designed to warm the incoming air only to a temperature of 70° to 75° in zero weather, the additional heat necessary to maintain the temperature in the auditorium being supplied by concealed direct radiators. The tempering coils are designed to raise the temperature of the incoming air when at a temperature of zero to 60° F, the re-heating coils furnishing the balance of the heat, 15°, when 60,000 feet of cubic air is delivered through them per minute. The tempering coils are made up of two-row and four-row sections and each set of re-heating coils is made up of two-row sections, having 5,500 square inches of free circulating area. The total heating surface of the two tempering coil and re-heating coil installations is thus approximately 18,800 lineal feet of one-inch pipe.

The incoming air in each fan room



PLAN OF VENTILATING APPARATUS A ON FIFTH FLOOR OF CLEVELAND HIPPODROME AUDITORIUM



DETAIL PLAN OF VENTILATING APPARATUS A. CLEVELAND HIPPODROME AUDITORIUM

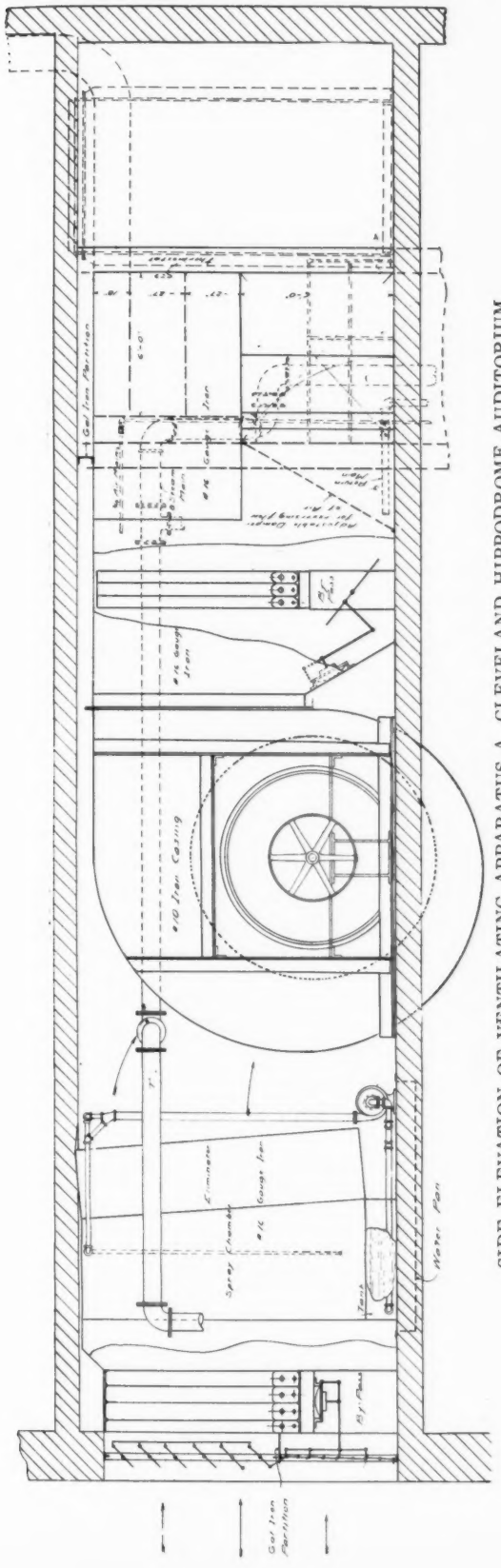
passes through an air washer of proper capacity located between the tempering coil and the fans.

Both tempering and re-heating coils are supported on platforms constructed of I beams which extend from the fourth to the fifth floor level. With each coil unit is one or more by-pass dampers having a free area of 6,000 square inches and equipped with thermostat and damper regulator.

SUPPLY AND EXHAUST DUCTS

The supply ducts connect with the auditorium at the points shown on the cut, inlets being placed above and below the gallery floor, below the second balcony floor for the ventilation of the upper foyer floor, and below the upper foyer floor, for the ventilation of the orchestra and of the foyer. The exhaust ventilation system for the main part of the auditorium draws the vitiated air into ducts or chambers under the main floor of the auditorium and between the ceiling and floor of the balcony and gallery. These chambers or ducts are connected directly with the vertical duct in the manner indicated in the illustration.

The exhaust chamber under the main auditorium floor is made of galvanized iron, stiffened every 36 inches with 1½ inch angle joints, lock-seamed and riveted. The galvanized iron work forming this chamber is made up of two compartments, each



SIDE ELEVATION OF VENTILATING APPARATUS A, CLEVELAND HIPPODROME AUDITORIUM

provided with openings on the under side and at each duct leading to the vertical flue. The openings are made tight with rubber stops.

The ventilating ducts from the proscenium boxes and from the rehearsal room, which is situated directly above, are carried upward and through the roof in the manner shown. Provision has been made in the ventilating duct in the attic over the rehearsal room for exhausters of proper capacity in case they should be found necessary. These ducts extend 6 feet above the roof line and have a ventilating hood.

REVERSAL DAMPERS

A feature of the system as constructed is the installation of all necessary doors, slides or dampers for reversing the system of ventilation. These dampers are so arranged that the direction of the inlet and outlet currents can be directed downward or upward without interfering with the operation of the fans.

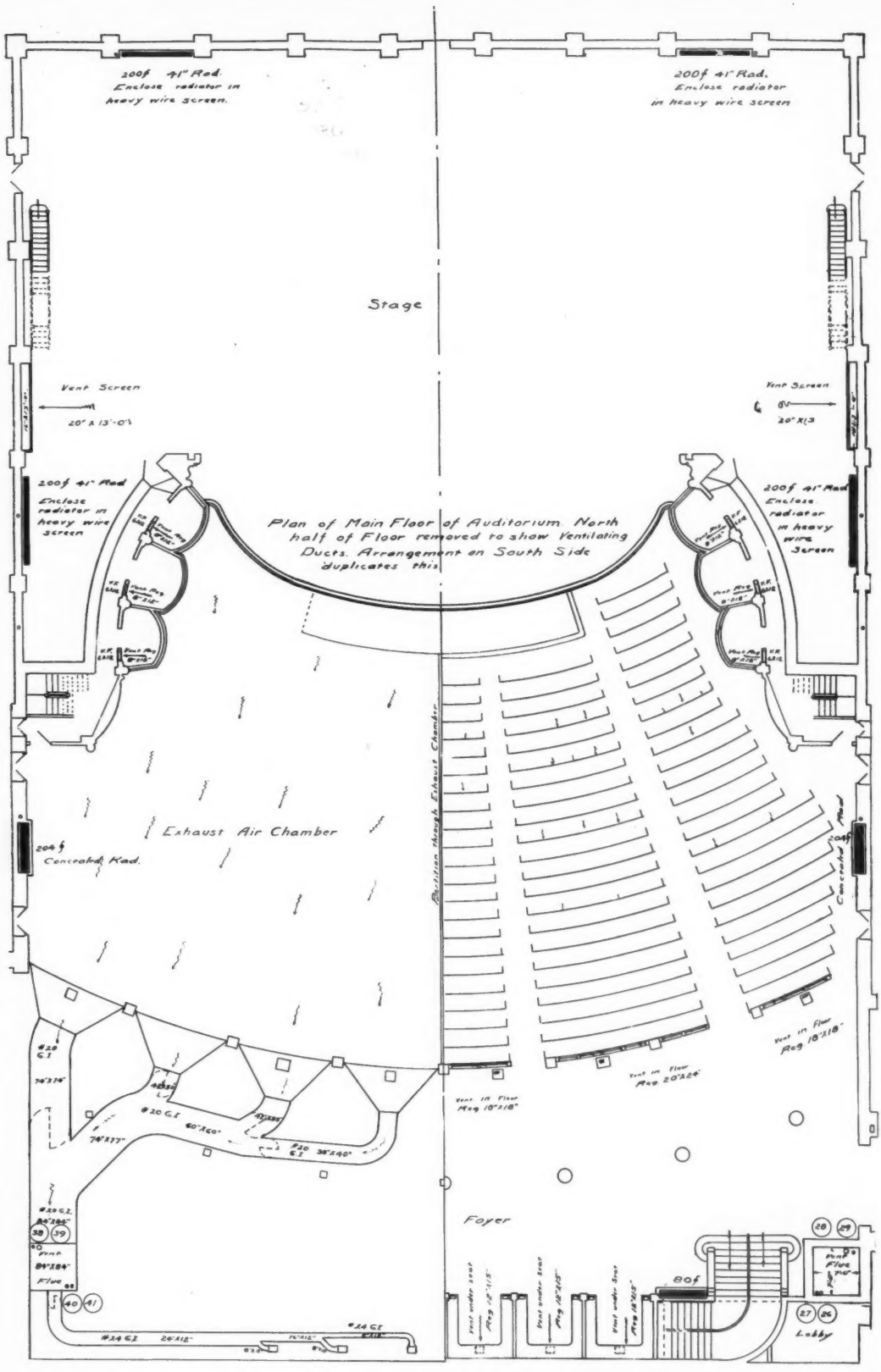
FRESH AIR AND EXHAUST OPENINGS

The fresh air openings on the main floor, balcony and gallery floors are provided with sheet metal diffusers to direct the inward flow of air outward and upward. They are designed to conform to the radii of the coves and the faces of the diffusers extend the full length of the cove from side to side of the room. The galvanized iron nozzles extending from openings to ducts are provided with volume dampers with extended operating levers.

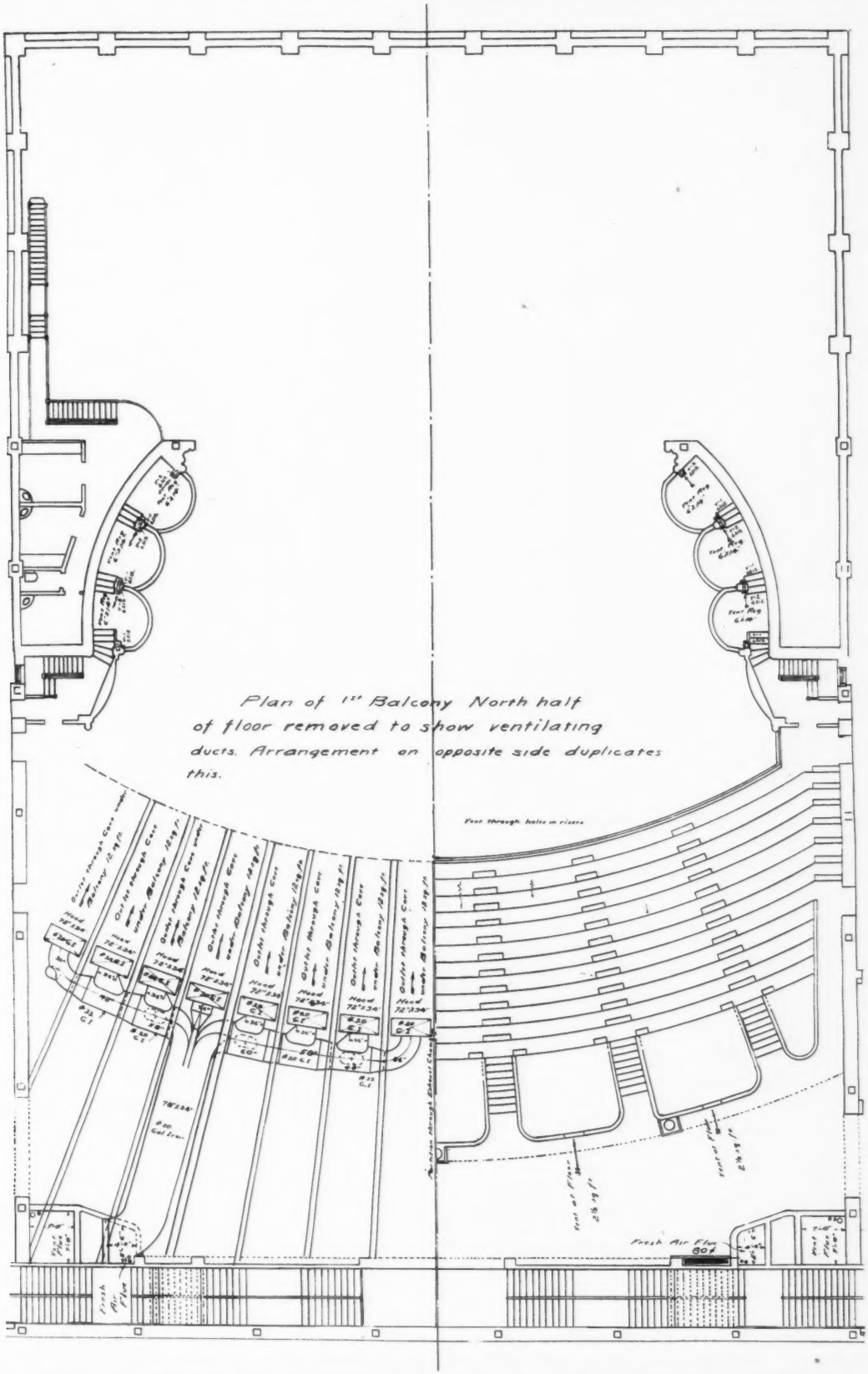
The exhaust openings are fitted with sheet metal louvers with blades not more than 1½ inches apart and curved to suit the location of the flue in the room. Each opening is provided with a suitable damper.

VENTILATION OF STAGE

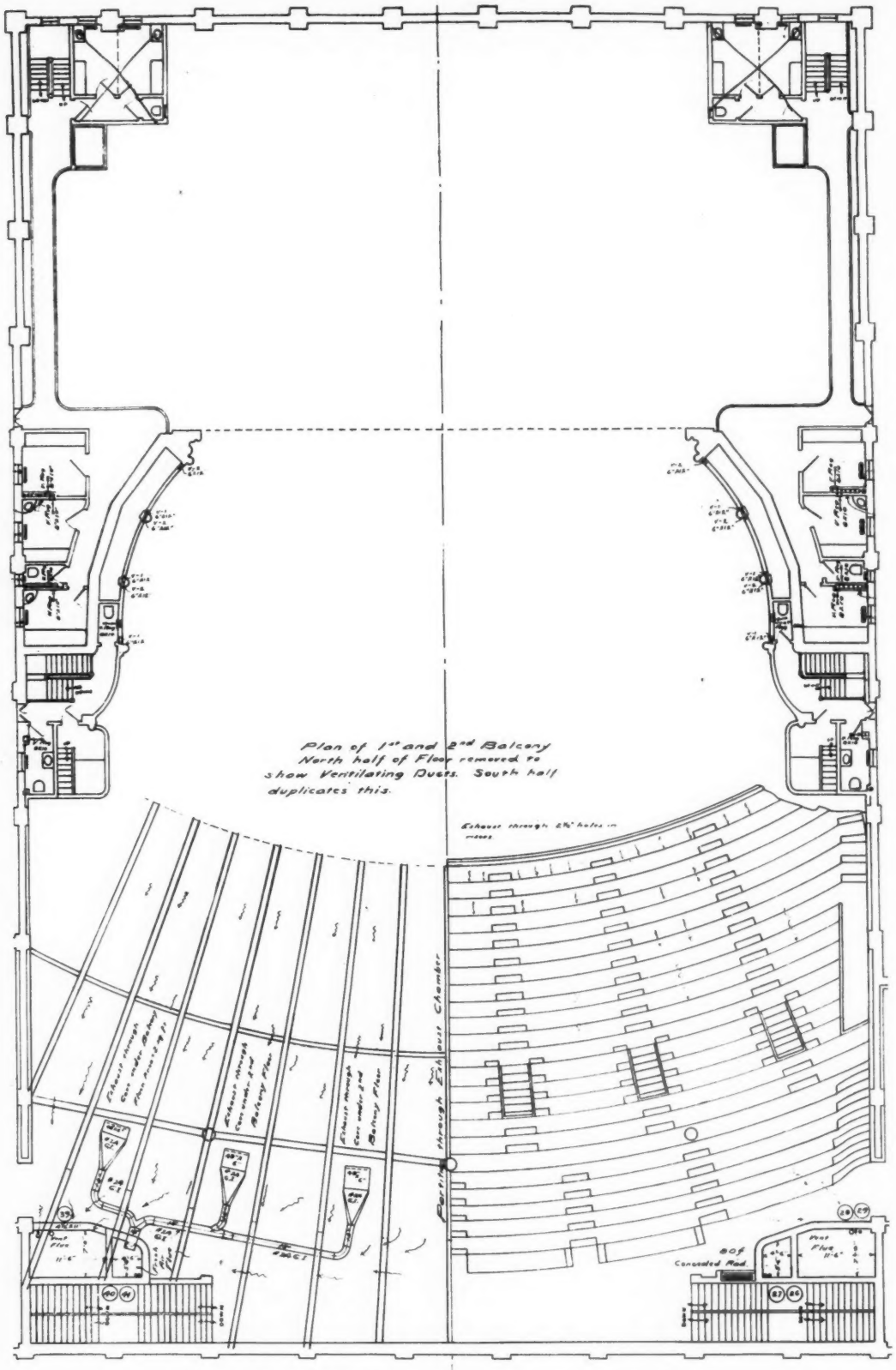
The ventilation of the stage portion of the auditorium is accomplished by means of a vent flue, 16x13 feet, connected with a horizontal duct in the basement, made of concrete, proper dampers being furnished.


200f 41" Rad.
Enclose radiator in heavy wire screen.
200f 41" Rad.
Enclose radiator in heavy wire screen
Stage
Vent Screen
20" X 13'-0"
Vent Screen
20" X 13
200f 41" Rad
Enclose radiator in heavy wire screen
Plan of Main Floor of Auditorium. North half of Floor removed to show Ventilating Ducts. Arrangement on South Side duplicates this
200f 41" Rad
Enclose radiator in heavy wire Screen
Partition through Exhaust Chamber
Exhaust Air Chamber
204 f
Concealed Rad.
Concealed Rad
Vent in Floor Reg 18"X18"
Vent in Floor Reg 20"X24"
Vent in Floor Reg 18"X18"
Foyer
80f
Lobby

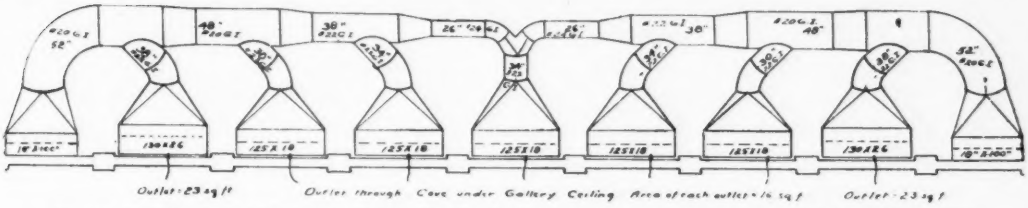
PLAN OF EXHAUST SYSTEM OF VENTILATION FOR MAIN FLOOR OF CLEVELAND HIPPODROME AUDITORIUM


Plan of 1st Balcony North half
of floor removed to show ventilating
ducts. Arrangement on opposite side duplicates
this.

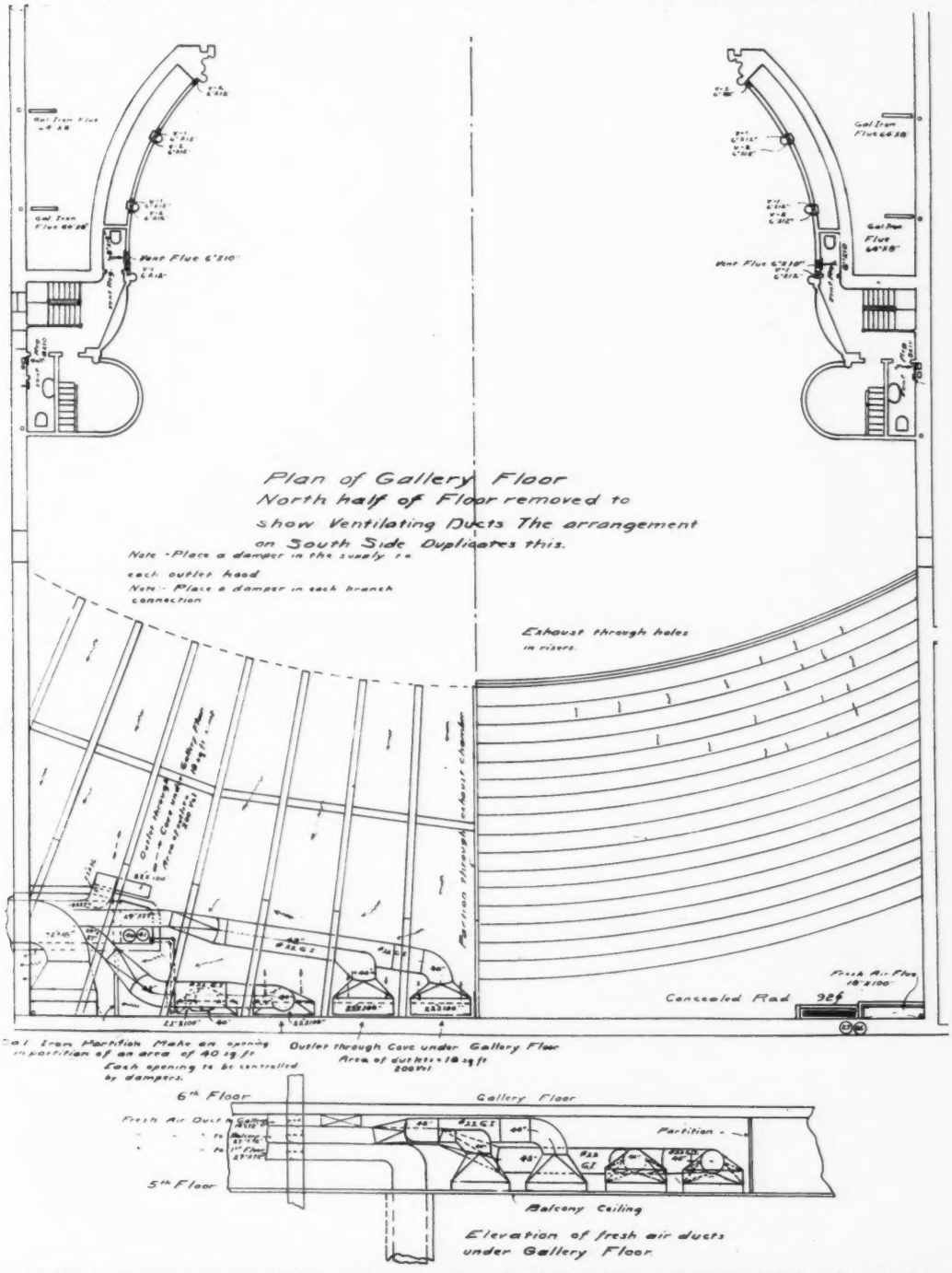
PLAN OF EXHAUST AIR CHAMBER FOR FIRST BALCONY, CLEVELAND HIPPODROME AUDITORIUM, SHOWING ALSO FRESH AIR DUCT FOR MAIN FLOOR


Plan of 1st and 2nd Balcony
North half of Floor removed to
show Ventilating Ducts. South half
duplicates this.
Exhaust through 6" holes in risers
Exhaust through Cast under Balcony Floor
Exhaust through Cast under 2nd Balcony Floor
Exhaust through Cast under 2nd Balcony Floor
Exhaust Air Chamber
80 ft Concealed Rod

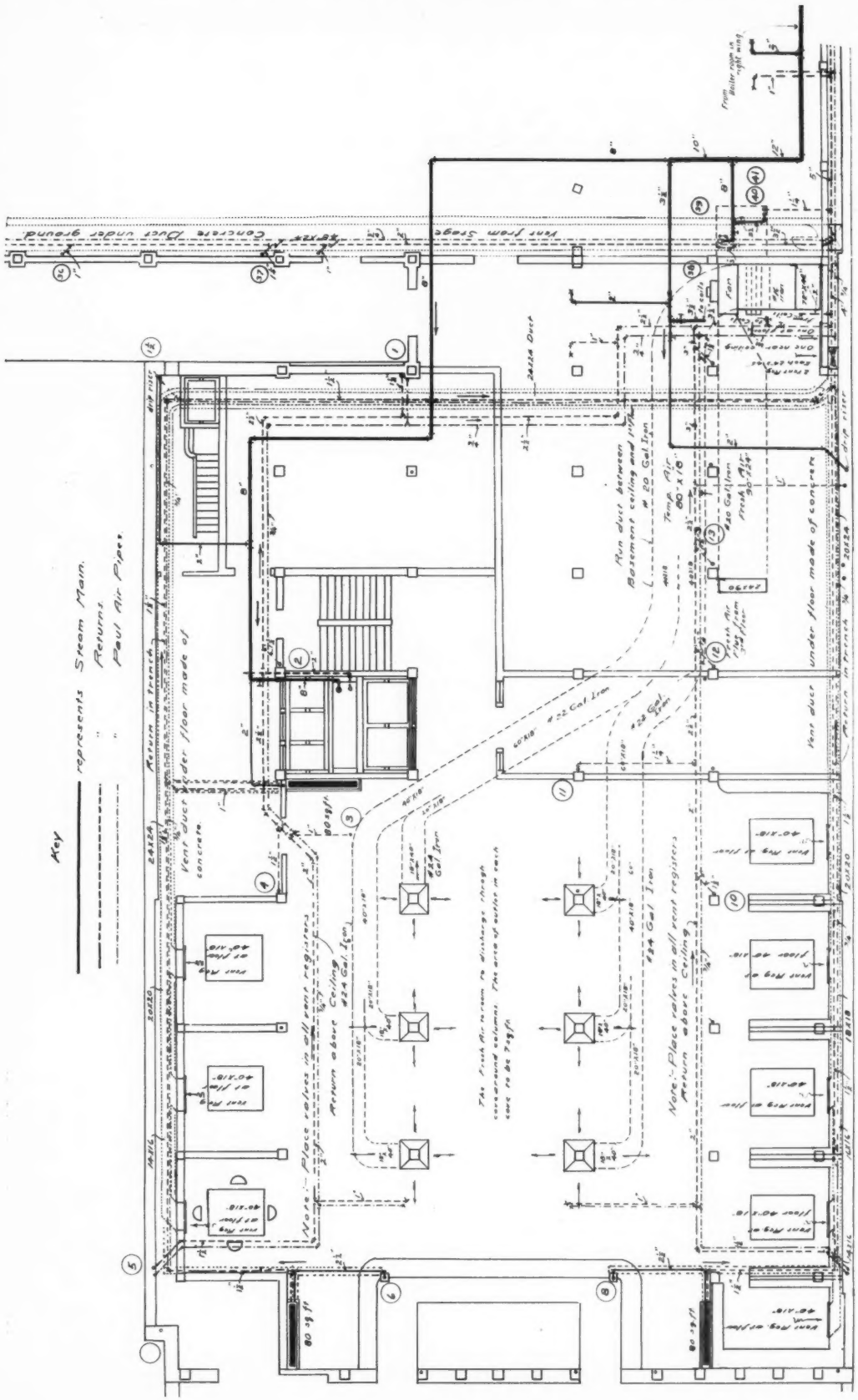
PLAN OF EXHAUST AIR CHAMBER FOR FIRST AND SECOND BALCONIES, CLEVELAND HIPPODROME AUDITORIUM, SHOWING ALSO FRESH AIR DUCT FOR UPPER FOYER



PLAN OF FRESH AIR DUCT FOR GALLERY, CLEVELAND HIPPODROME AUDITORIUM


Plan of Gallery Floor
North half of Floor removed to
show Ventilating Ducts The arrangement
on South Side Duplicates this.
Note - Place a damper in the supply to each outlet hood
Note - Place a damper in each branch connection
Exhaust through holes in risers.
Concealed Rad
Fresh Air Flue
Gal Iron Partition Make an opening in partition of an area of 40 sq ft Each opening to be controlled by dampers.
Outlet through Cove under Gallery Floor
Area of outlets = 18 sq ft
6th Floor
Gallery Floor
Fresh Air Duct
Partition
5th Floor
Balcony Ceiling
Elevation of fresh air ducts under Gallery Floor

PLAN OF EXHAUST CHAMBER FOR GALLERY OF CLEVELAND HIPPODROME AUDITORIUM, SHOWING ALSO FRESH AIR DUCTS FOR BALCONY


Key
represents Steam Main.
" Returns.
" Foul Air Pipes.
Fan from Stage
Concrete Duct under ground
Return in trench
Vent duct under floor made of concrete.
Run duct between Basement ceiling and floor
Temp. Air 80 x 16
Fresh Air 30 x 24
Vent duct under floor made of concrete
Return in trench
Note:- Place valves in all vent registers Return above Ceiling
Note:- Place valves in all vent registers Return above Ceiling

PLAN OF HEATING AND VENTILATING SYSTEM IN BASEMENT OF EUCLID AVENUE WING OF NEW CLEVELAND HIPPODROME BUILDING. BLAST COIL CONNECTIONS ARE ARRANGED SO THAT CONDENSATION FROM NORTH WING OR STEAM MAY BE CIRCULATED THROUGH COILS

VENTILATION OF THE RATHSKELLER

The general system of ventilation provided for the auditorium was adopted also in the rathskeller, located in the basement of the office building.

A 60-inch steel plate fan, capable of delivering 12,000 cubic feet of air per minute under a pressure of one ounce, at a speed of 235 revolutions per minute and operated by a direct current enclosed type, variable speed motor furnishes the supply of fresh air which passes through tempering and re-heating coils containing 2,000 lineal feet of one-inch pipe. The arrangement of these coils is similar to that described for the main auditorium. This system which furnishes fresh air at a temperature of 75 degrees during zero weather is augmented by concealed direct radiation.

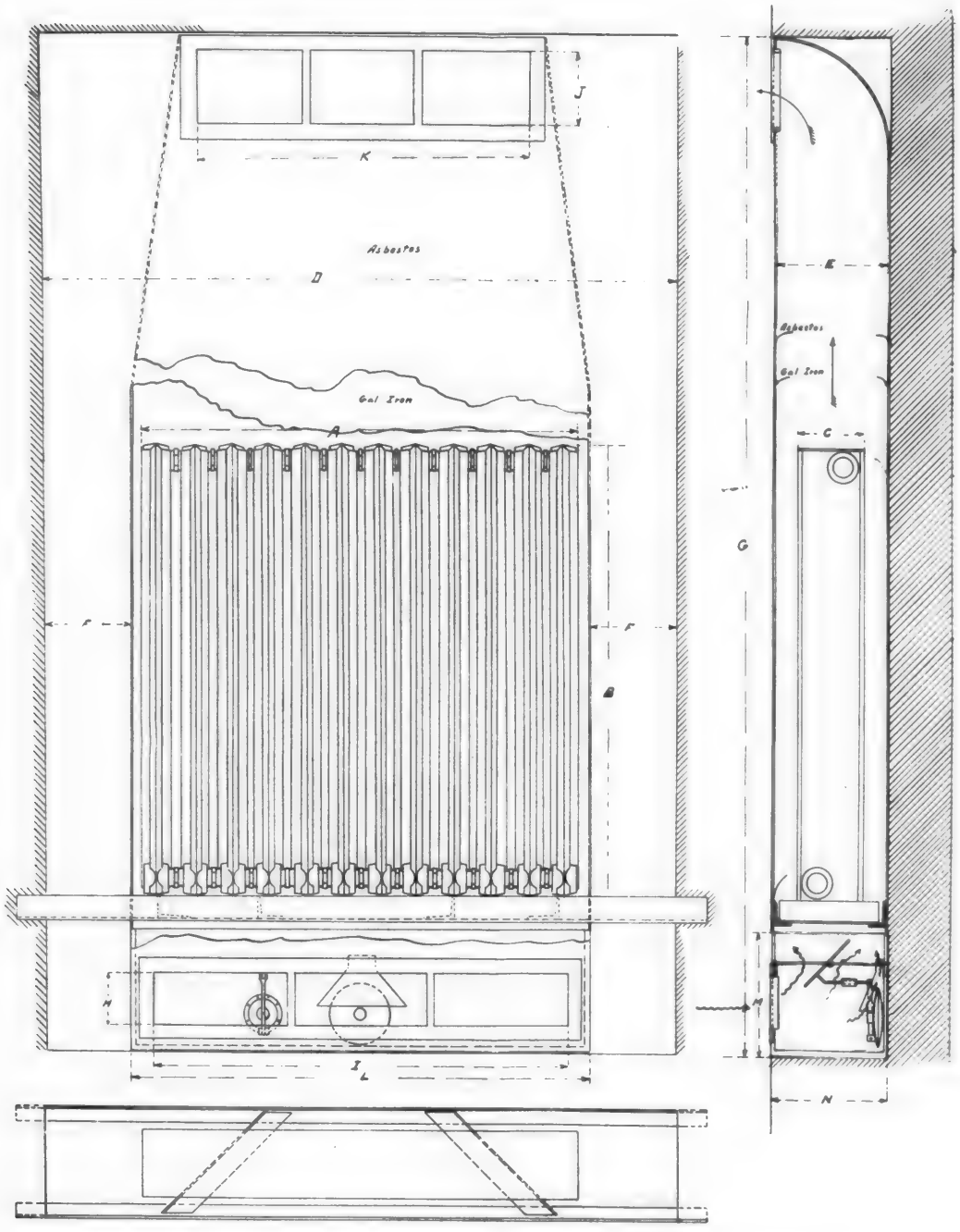
The foul air is removed through a duct leading to the aspirating chimney, located in the engine room. An air washer of the proper capacity washes the fresh air entering the rathskeller.

The coils for the rathskeller are arranged for hot water circulation as well as steam, under which arrangement the water used in the coils will be secured from the return main of the heating system of the main building. The connection to the return main is made in the form of a by-pass, so that the amount of water circulating through the heater may be regulated to suit the requirements. Provision is also made for steam connections to both coils so that either one or both may be used for hot water or steam. The coils are supported in a similar manner to those in the main auditorium, and there are also similar by-passes and damper regulator.

FRESH AIR IN EXHAUST OPENINGS

Fresh warmed air is admitted to the rathskeller around the columns, the openings being concealed by ornamental decorations and the air discharged upward through ornamental chapiters. Each discharge opening is provided with a suitable damper. The exhaust openings are located at

PLAN OF REHEARSAL ROOM ABOVE STAGE OF CLEVELAND HIPPODROME AUDITORIUM, SHOWING ARRANGEMENT FOR CONNECTING FLUES FROM BOXES, DRESSING ROOMS AND TOILETS



DETAIL SHOWING METHOD OF INSTALLING CONCEALED DIRECT RADIATORS IN CLEVELAND HIPPODROME AUDITORIUM

the floor line in the partitions or wood finish. These openings are faced with registers of ornamental design, with dampers, and arranged so that refuse will be excluded.

HEATING SYSTEM

The heating plant arranged for the auditorium and rathskeller, as well as for the office building, is low steam pressure, complete circuit or return

riser system of direct heating. It is designed to utilize all of the exhaust steam available and to augment same by live steam to maintain a steam circulation at or below atmospheric pressure. For this purpose, the Paul System is installed.

From a point in the engine room, adjacent to the boiler stack, a 12-inch steam main is run to the point indicated on the plans of the basement of the Euclid avenue building, and from this main vertical risers are taken to the fifth floor of the auditorium building and to the attic of the Euclid avenue building. The vertical supply main for the Prospect avenue building is the main exhaust pipe extending to the roof, which is provided with proper connections at the attic floor level for the horizontal main.

The steam supply main in the attic of both office buildings is looped with an independent drip return at the lowest point of each horizontal supply main forming the loop. Relays are installed where necessary in the basement and in the attics to preserve the pitch specified of ¾ inches to every 10 feet of pipe and where "jumping up" of all horizontal mains is necessary to get around the steel work.

The connections to all return risers are taken from the horizontal steam mains and are one size larger than the riser to which they are connected. These connections are made not less than 15 feet in length and have a pitch of 3 inches toward each return riser. Return mains are placed in trenches under the basement floor.

The risers for the Euclid avenue building are anchored at the sixth floor level and those in the Prospect avenue building at the fourth floor level.

LIVE STEAM SUPPLY

The live steam supply to the heating system is taken from an 8-inch flanged fitting on the high pressure steam line in the boiler room and connected with the low pressure steam main through a reducing valve, with by-pass.

Radiators for the office buildings are of the Perfection type made by the American Radiator Company. Those in the toilet rooms of the auditorium and at some other points are of the Colonial wall pattern, while in a number of recesses, the Vento radiator is used, enclosed in galvanized iron casing and lined on outer sides with ⅛-inch sheet asbestos. A casing for each of these radiators is made up of two sections, the upper section being in the form of a flue, curved at the top to suit a vertical opening in side of wall to which is fitted a register face. The lower compartment is made in the form of a box in which is placed a damper, thermostatically operated. The air supply for the radiator is taken at the side of the compartment through a suitable register. The steam and air connections are made through openings in the sides of the upper section of the casing.

The radiating surface for the stage and in the basement under the auditorium is made up of pipe coils.

WATER SUPPLY FOR SPRINKLER AND FIRE SYSTEM

The sprinkler system is confined to the auditorium and the fire service to the auditorium and office buildings. The water supply for both systems is taken from a 40,000 gallon tank, located on the third floor of the Euclid avenue building, from two 6-inch city mains for direct pressure to suction of a 1,000 gallon underwriter fire pump, and from the Hippodrome tank which contains approximately 275,000 to 300,000 gallons.

Knox & Elliott are the architects of this building, and the John P. Cowing Engineering Company are in charge of the structural engineering. The engineers for the power equipment, including the heating and ventilating, were the Hoit Engineering Company, of Cleveland, the Knox Engineering Company, of Chicago, being the associate engineers for the power equipment. The heating and ventilating and air washing apparatus was furnished by Andrews & Johnson, of Chicago.

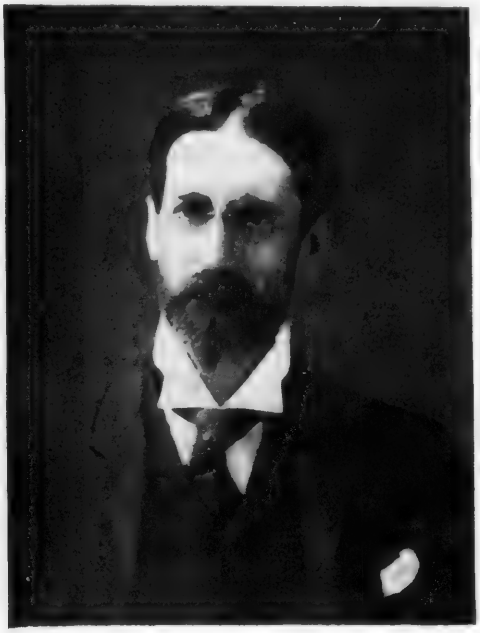
AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Thirteenth Annual Meeting, Held at the New Engineering Building, New York, January 22-24, 1907

To the American Society of Heating and Ventilating Engineers falls the honor of christening the new United Engineering building, on West Thirty-ninth street, New York, the gift of Mr. Andrew Carnegie to the engineering profession. The society's sessions, to be held there January 22-24 next, will be the first technical meeting of any kind to be conducted within the halls of this sumptuous new structure. It was the intention to hold the recent meeting of the American Society of Mechanical Engineers in the new Engineering building, but at a late hour it was found the interior would not be ready in time, so that other plans had to be made.

The building is located on Thirty-ninth street, between Fifth and Sixth avenues, and can be most conveniently reached by Sixth avenue surface cars or elevated trains or by Broadway surface cars.

The arrangements for the presence of the ladies this year at the annual dinner insures a large attendance of the fair sex, whose headquarters are at the New Grand Hotel, Thirty-first street and Broadway, quick connection being made with the Engineering building by both Broadway and Sixth avenue cars. Mrs. C. B. J. Snyder is the chairman of the New York ladies reception committee, all of whom may be distinguished by the wearing of white ribbons attached to Society buttons. In addition to Mrs. Snyder, this committee includes Mrs. William M. Mackay, Mrs. U. G. Scollay, Mrs. H. J. Barron and Mrs. J. A. Connolly.



REGINALD PELHAM BOLTON, NEW YORK

C. B. J. SNYDER, NEW YORK

THE NOMINEES FOR PRESIDENT

On Tuesday, January 22, the opening day of the meeting, there is a reception to the visiting members and to the ladies in the meeting room of the new Engineering building, from 1 to 2 o'clock, at which the New York ladies' auxiliary committee will be in attendance.

On the evening of the second day, January 23, there will be a general reception

to the members and guests in the parlors of the New Grand Hotel, from 6 to 8 o'clock. At the close of the reception, the annual dinner of the society will be served in the dining-hall.

Among other features of the meeting that have been formally announced are invitations to inspect the heating, ventilating and mechanical equipment of the new Engineering building, and the mechanical equipment of the new DeWitt Clinton High School at Fifty-ninth street and Tenth avenue, both of which are down for Wednesday morning, January 23. Following is the programme for the entire meeting:

Courtesy Bi-Monthly Bulletin, A. I. M. E.

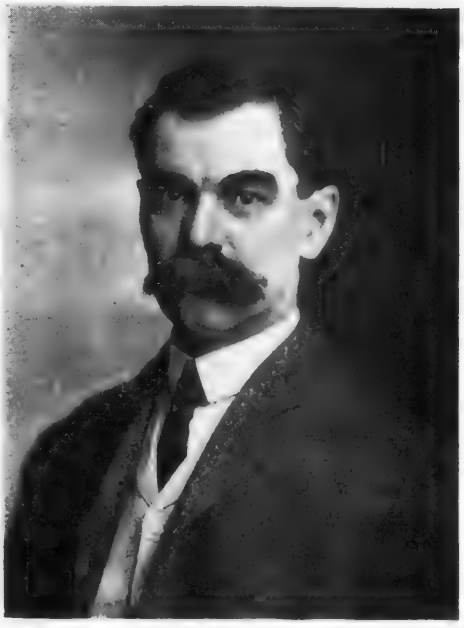
THE NEW ENGINEERING BUILDING

Where the American Society of Heating and Ventilating Engineers holds its Thirteenth Annual Meeting January 22–24, 1907

FIRST DAY—TUESDAY JANUARY 22

Reception to visiting members and their ladies, in the meeting room in the new Engineering building, 29 West Thirty-

T. J. WATERS, CHICAGO, ILL.



JAMES MACKAY, CHICAGO, ILL.
Chairman of Committee to Collect Data on Hot Water Heating

THE NOMINEES FOR VICE-PRESIDENT

ninth street, from 1 to 2 o'clock Tuesday afternoon. A New York ladies' auxiliary committee will be in attendance. Their headquarters during the meeting will be in the New Grand Hotel, Broadway and Thirty-first street.

AFTERNOON SESSION

Roll Call.
Reading of Minutes of Previous Meeting.
President's Address.
Report of Secretary.
Report of Treasurer.

WILLIAM G SNOW, BOSTON, MASS.

PROF. JAS. D. HOFFMAN, LAFAYETTE, IND.

THE NOMINEES FOR SECOND VICE-PRESIDENT

WILLIAM M. MACKAY, NEW YORK

THOMAS BARWICK, NEW YORK

THE NOMINEES FOR SECRETARY

Report of the Board of Governors.
Reports of Standing Committees.
Reports of Special Committees.
Appointment of Tellers.
New Business.

EVENING SESSION

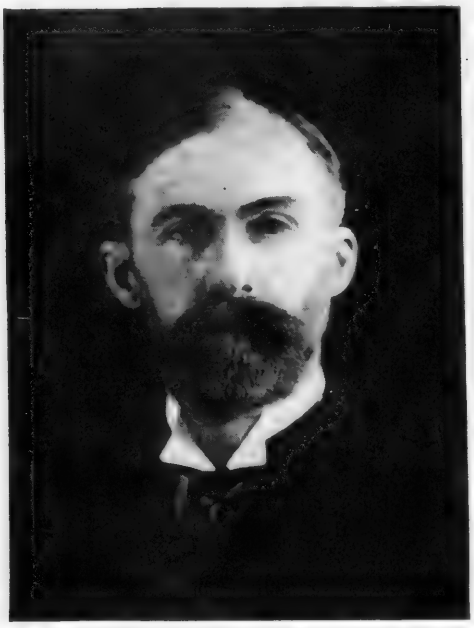
Tuesday, January 22, 8 o'clock

Report of Tellers.
Reading of Paper—"Standard Sizes of Steam Mains," by J. A. Donnelly (member of the Society).
Discussion.
Reading of Paper—"Flow of Steam in Pipes," by Wm. Kent (member of the Society).
Discussion.
General Discussion.
Topics for Discussion:

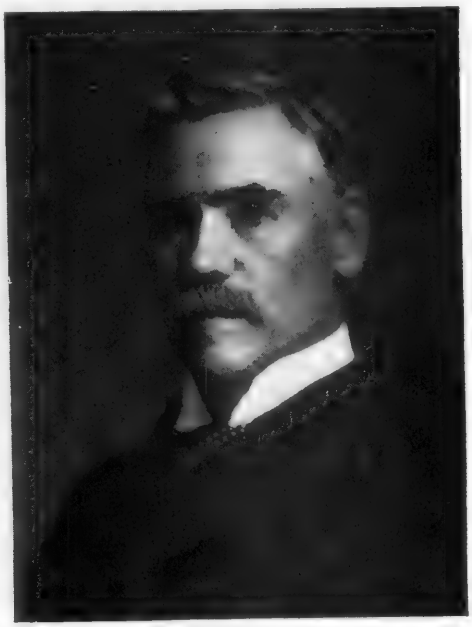
U. G. SCOLLAY, BROOKLYN, N. Y.

FRANK P. BLODGETT BROOKLYN, N. Y.,

THE NOMINEES FOR TREASURER



B. F. STANGLAND, NEW YORK
Nominated for Board of Governors



PROF. R. C. CARPENTER, ITHACA, N. Y.
Nominated for Board of Governors

No. 1. Relation of steam and return connections to horse power in heating boilers.

No. 2. Size of safety valve for heating boilers, under varying pressures up to ten pounds.

SECOND DAY

Wednesday Morning, January 23

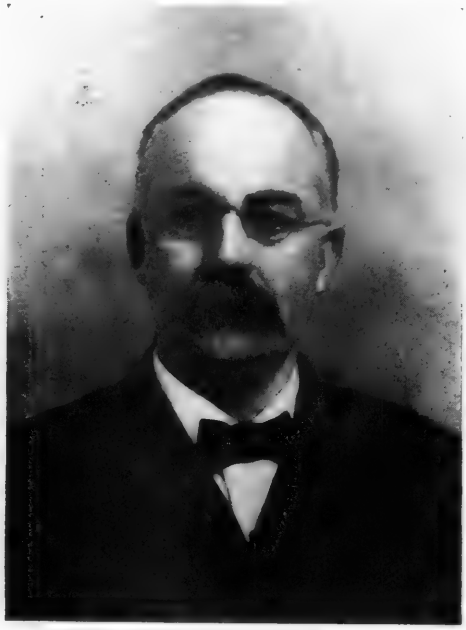
Inspection of new Engineering building and its heating, ventilating and mechanical equipment.

Inspection of the mechanical equipment of the DeWitt Clinton High School, Fifty-ninth street and Tenth avenue, New York.

SECOND DAY—AFTERNOON SESSION

Wednesday, January 23, 2 o'clock

Reading of Paper—"Temperatures for Testing Indirect Heating Systems," by



A. B. FRANKLIN, BOSTON, MASS.
Nominated for Board of Governors

FRANK K. CHEW, NEW YORK
Nominated for Board of Governors

JOHN F. HALE, CHICAGO, ILL.
Nominated for Board of Governors

B. HAROLD CARPENTER, WILKES-BARRE, PA.
Nominated for Board of Governors

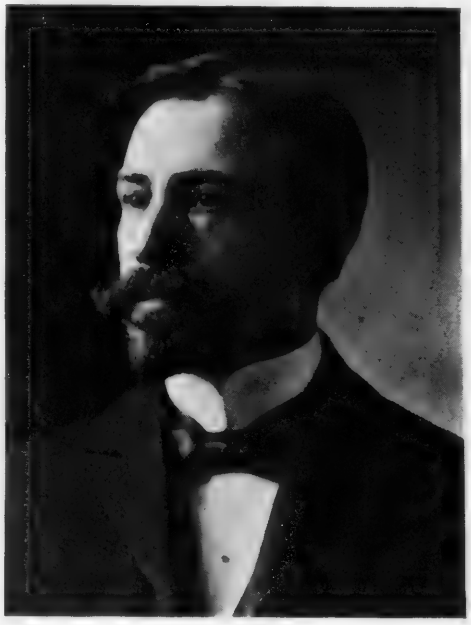
W. W. Macon (non-member of the Society). Presented by request.
Discussion.
Report of Special Committees.
Reading of Paper—"The Derivation of Our Constants for Building Losses," by R. C. Carpenter (member of the Society).
Discussion.

General Discussion.
Topics for Discussion:

No. 3. In the so-called fan or forced blast system of heating, how should the amount of heating surface in the tempering and heating coils be determined in view of the variation in practice?

No. 4. Fuel required to operate a district heating plant and electric plant com-

WILLIAM H. McKIEVER, NEW YORK
Nominated for Board of Governors



A. M. FELDMAN, NEW YORK
Nominated for Board of Governors

ROBT. E. ATKINSON, LEICESTER, ENG.
Nominated for Board of Governors

J. J. BLACKMORE, NEW YORK
Chairman of Committee to Collect Data on Steam Heating of Small Buildings

bined, using exhaust steam for heating as compared with a heating plant alone using direct steam.

No. 5. The air space required through hot blast heaters.

On the adjournment of the afternoon session, there will be a general reception to the members, their ladies and guests, in the parlor of the New Grand Hotel from 6 to 8 o'clock.

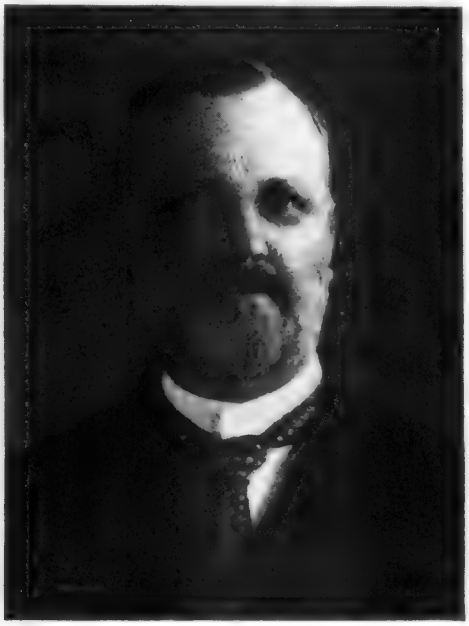
At the close of the reception, the annual dinner will be served in the dining hall.

THIRD DAY—MORNING SESSION

Thursday, January 24, 10:30 o'clock

Reading of Paper—"Comparison of Quick Circulating Systems of Hot Water Heating," by C. Guitton, St. Etienne, France (non-member of the Society). Presented by request.

JAMES A. DONNELLY, NEW YORK
Chairman of Committee to Collect Data on Standard Sizes of Steam and Return Mains



EX-PRESIDENT WILLIAM KENT, SYRACUSE, N. Y.
Chairman of Committee on Standards and of Committee to Collect Data on Furnace Heating

Discussion.
Reading of Paper—"Systems of Heating Railway Cars with Hot Water," by R. C. Carpenter (member of the Society).
Topics for Discussion:

No. 6. The Relative Healthfulness of direct and indirect heating systems.

No. 7. The variation of the boiling point under the same degree of vacuum at different altitudes.

No. 8. Rated surface of radiators versus actual surface.

THIRD DAY—AFTERNOON SESSION

Thursday, January 24, 2 o'clock

Reading of Paper—"Relation of the Force of Gravity to Some of the Economics of Heating," by Dr. J. M. W. Kitchen, East Orange, N. J. (non-member of the Society). Presented by request.
Discussion.
Reading of Papers.
Discussion.
Installation of Officers.
New Officers Assume Their Duties.
Topics for Discussion:

No. 9. Durability of steel and wrought iron pipes used as returns for exhaust steam heating, also when high pressure steam free from oil is used.

No. 10. Expansion of pipes due to heat from steam, high pressure 100 pounds and upward, and 10 pounds and under.

No. 11. Advantages of standard dimensions of radiator valves and connections.

No. 12. Should the guarantee of efficiency be assumed by the heating engineer who designs the apparatus or the heating contractor who installs it?

Topical Discussion.
Adjournment.

Standard Sizes of Steam Pipes*

By James A. Donnelly

The subject of the proper sizes of steam mains has usually been discussed with all, or almost all, of the different elements considered as variable.

If as many of the variable elements as possible are eliminated very much progress may be made toward agreement.

It has been suggested that smaller pipes might be used when the pressure of steam is increased, but there seems to be no good reason why a larger drop should be desired when a higher pressure is to be used. It is certain that the saving in first cost would not warrant the resulting decrease in efficiency.

The change in the density of steam, and resulting friction, as pressures somewhat above or below atmosphere are used is very nearly offset by the changing rate of condensation due to the change in temperature. So that the amount of direct radiation that may be put upon pipes for a uniform drop is practically the same for reasonable differences in pressures; as will be seen by the annexed table.

The comparatively slight difference that does exist favors the practice of an increase of radiation as the pressure is reduced, rather than the opposite, as has been usually maintained.

If a plant is designed to run at ten pounds pressure in the coldest weather and with quite a large drop, it could not be considered a successful piping system if it failed to heat all radiators with a very slight pressure in mild weather; or if it did not work properly when steam was being raised or lowered. Therefore it would seem logical to figure all steam mains with steam at substantially atmospheric pressure.

It has sometimes been stated that different methods of heating might call for

*Paper read at the Thirteenth Annual Meeting of the American Society of Heating and Ventilating Engineers, New York, Jan. 22-24, 1907.

CAPACITY OF STEAM MAINS WITH VARYING PRESSURES

Gage Pressure	Tem.	B. T. U. Per Sq. ft. Per Deg.	B. T. U. Per Sq. ft. Rad. Sur.	Lbs. Steam Per Sq. ft. Rad. Sur.	Sq. ft. Radn. 10" Pipe 1-oz Drop	Velocity Feet Per Second
26-in. V.	126°	1.768	99	.0965	28,000	235
24 "	141°	1.817	129	.127	25,700	193
22 "	153°	1.88	156	.155	24,100	170
20 "	162°	1.9	174	.174	23,800	152
18 "	170°	1.95	195	.196	23,100	140
16 "	177°	1.99	213	.215	22,600	130
14 "	183°	2.03	230	.234	22,500	123
12 "	188°	2.06	243	.247	22,400	116
10 "	193°	2.08	256	.262	22,325	110
8 "	198°	2.09	268	.275	22,270	105
6 "	202°	2.1	277	.285	22,225	101
4 "	206°	2.11	287	.296	22,180	97
2 "	209°	2.111	293	.303	22,150	93
0 lbs.	212°	2.112	300	.31	22,000	90
5 "	228°	2.22	351	.368	21,600	80
10 "	240°	2.26	384	.406	21,000	72
15 "	250°	2.28	410	.438	20,600	65

different standards of pipe sizes, but as it is impossible for any method, no matter how perfect, to work contrary to the laws that govern the flow of steam in pipes and as an increase in velocity is always attended by a decrease in efficiency, the same standard of sizes of steam mains is advisable with all methods of circulation.

Many attempts have been made to introduce new and improved methods, a lower steam pressure and a smaller standard of pipe sizes simultaneously; but if the method is successful it undoubtedly meets with its best success when the regular sizes of steam mains are not reduced.

It has been suggested that the maximum velocity permissible for all systems using fairly dry steam from 25 inches of vacuum to 15 pounds gage pressures should be that which would require not more than one ounce difference in pressure for one hundred feet run in straight pipe to maintain

run in straight pipe, the question is narrowed down to the formula which is preferable by reason of correctness and convenience for constructing a table for use in determining steam main sizes.

The formulas in common use have certainly run to extremes, as they range all the way from the very old and familiar one of $R = D^2 \times 100$ to $R = D^3 \times 25$. In these and the following formulas R is direct radiating surface and D is diameter in inches. With neither of these has the resulting drop in pressure been given, though F. R. Still has recently given the formula $R = D^3 \times 30$ and stated that this gave a drop of one ounce to 100 feet run in sizes up to 8 inches, above which the formula was not to be relied upon.

The formula $R = D^2 \times 100$ was seldom used or considered correct below 2 inches or above 6 inches. Pipes below 2 inches were called radiator connections and

SIZES OF STEAM MAINS FO DI

SHOWING LOSS OF PRESSURE IN OUNCES FOR 100-FOOT RUN. THE E

Nominal Sizes of

Velocity, ft. per sec.	10 Feet		20 Feet		30 Feet		40 Feet		50 Feet		60 Feet		70 Feet		80
Size of Main	Drop	Sq. Ft. Rad'n.	Drop	Sq. Ft. Rad'n.	Drop	Sq. Ft. Rad'n.	Drop	Sq. Ft. Rad'n.	Drop	Sq. Ft. Rad'n.	Drop	Sq. Ft. Rad'n.	Drop	Sq. Ft. Rad'n.	Drop
1 inch	.4	25	1.6	49	3.6	74	6.4	100	10.	124	14.4	148	19.6	174	25.6
1¼ inches	.29	39	1.16	77	2.61	116	4.64	155	7.25	194	8.28	232	11.4	271	14.72
1½ "	.2	56	.8	112	1.80	168	3.2	224	5.	280	7.2	336	9.8	392	12.8
2 "			.48	200	1.08	300	1.92	400	3.	500	4.32	600	5.88	700	7.68
2½ "					.75	465	1.34	620	2.1	775	3.02	930	4.1	1.085	5.37
3 "					.56	669	1.	892	1.56	1,115	2.25	1,338	3.06	1,561	4.
3½ "							.85	1,216	1.33	1,520	1.9	1,824	2.6	2.128	3.4
4 "							.66	1,600	1.04	2,000	1.5	2,400	2.04	2,800	2.66
4½ "							.53	2,005	.83	2,506	1.2	3,007	1.63	3,508	2.13
5 "							.48	2,480	.75	3,100	1.08	3,720	1.37	4,340	1.92
6 "									.57	4,470	.82	5,364	1.12	6,258	1.47
7 "									.45	6,083	.652	7,300	.887	8,516	1.16
8 "											.56	9,540	.66	11,130	1.
9 "													.637	14,095	.83
10 "													.57	17,360	.75
12 "															.60
14 "															
16 "															

it. It is believed that this maximum velocity would give very good results for all plants with reasonably short runs, and as the length increased the individual judgment of the engineer must be used to keep the total drop in pressure within the amount desired and available.

The fact is, of course, recognized that there are some conditions and circumstances which would render it advisable to use a lower velocity, such as an unusual number of elbows, but it should be applicable as a maximum velocity to all ordinary cases and conditions.

If it is conceded that a standard of steam main sizes would apply for all the various pressures and methods of circulation in common use and that the maximum velocity is in the vicinity of that which would give one ounce drop of 100 feet

came under another rule and plants at that time seldom ran above 6 inches. One of the chief objects of a formula should, however, be the possibility of extending construction to larger plants by its help and one good test for the correctness of a formula is to figure it to somewhat of an extreme.

It is probable that the average drop in both of the formulas cited, if taken in the sizes stated, would be very nearly one ounce to the 100 foot run, but there is absolutely no good authority for either formula as they are both more in the nature of empirical rules or rules of thumb.

The first one would make the proportionate carrying capacity of pipes vary as the square of their diameters or directly as their areas. This we know would not be correct unless they were absolutely

without friction. The second one would make the capacity vary directly as the cube of the diameter, which would be directly in proportion to their areas multiplied by the proportion between area and circumference; in other words directly as the proportion between friction surface and area.

The basis, however, of all generally-accepted formulas of flow has been that the friction varied about as the square root of the friction surface in proportion to area and this has come to be called, when referring to hydraulic formulas, the mean hydraulic radius. It is usually expressed $\sqrt{\frac{A}{6}}$ or $\sqrt{r}$. The comparative carrying capacity of pipes based on this is therefore $A\sqrt{r}$ and this is of the same proportionate value as the square root of the fifth power of the diameter or the diameter raised to the two and five-tenths power. Thus

steam and water, at least in smooth pipes. For rough pipes water is no doubt affected differently from steam, due to its comparative incompressibility.

If this proportion is correct for the flow of all other fluids in comparison with water it might be advisable to use a hydraulic formula or table of flow and convert the result into that for air, gas or steam by using the factor of the square root of the comparative density.

The results produced by a hydraulic formula may be changed into that for steam at atmospheric pressure by multiplying the velocity by 40 or dividing the weight delivered by the same number. In like manner the factor for air at 100 degrees is 30.

The formulas before mentioned, as well as the very widely known and much-used Kutter formula, figured for smooth pipes, have been changed in this manner and

O DIRECT RADIATION

ENTHS POUND CONDENSATION PER SQUARE FOOT PER HOUR

f e Used

	90 Feet		100 Feet		110 Feet		120 Feet		130 Feet		100 ft. Run 1 oz. Drop		Comparative Carrying Capacity of Pipes	
Rad'n.	Drop	Sq. Ft. Rad'n.	Drop	Sq. Ft. Rad'n.	Drop	Sq. Ft. Rad'n.	Drop	Sq. Ft. Rad'n.	Drop	Sq. Ft. Rad'n.	Velocity	Sq. Ft. Rad'n.		Size of Main
6 198	32.4	224	40.	248							15.8	40	1.	1
72 340	23.5	350	29.	388							18.5	75	1.9	1¼
8 448	16.2	504	20.	560							22.5	126	3.2	1½
68 800	9.62	900	12.	1.000							29.	286	7.2	2
37 240	6.8	1,395	8.4	1.520							34.5	535	13.5	2½
884	5.06	2.007	6.25	2.230							40.	890	22.5	3
4 432	4.3	2.736	5.31	3.040							43.4	1.360	34.4	3½
66 200	3.37	3,600	4.16	4,000							49.	1.950	50.	4
13 009	2.69	4,510	3.33	5,012							54.8	2.747	68.6	4½
92 960	2.43	5,580	3.	6,200							58.	3,600	91.3	5
47 152	1.86	8,046	2.3	8,940							66.	5,900	150.	6
16 733	1.46	10,950	1.81	12,167							74.3	9,040	226.	7
720	1.26	14,310	1.56	15,900	1.89	17,540	2.25	19,080			80.	12,700	322.	8
83 109	1.06	18,123	1.3	20,137	1.58	22,150	1.87	24,157	2.2	26,170	87.4	17,600	440.	9
75 540	.95	22,320	1.18	24,800	1.43	27,280	1.7	29,760	2.	32,240	92.	22,900	582.	10
60 440	.76	32,220	.94	35,800	1.14	39,380	1.36	42,960	1.7	46,540	103.	37,000	938.	12
	.63	43,830	.78	48,700	.95	53,570	1.13	58,440	1.32	63,310	113.	55,300	1403.	14
	.53	57,240	.66	63,600	.80	69,960	.95	76,320	1.12	82,680	123.	78,300	1982.	16

we have $D^{2.5} \times 2.546 = A\sqrt{r}$

Unwin's formula, which has been adopted by Babcock, and as applied to steam has come to be known as the Babcock formula, makes the comparative carrying capacity of pipes vary as $D^{2.5} \times \sqrt{\frac{D}{D+3.6}}$ which in the sizes from one to sixteen inches is substantially equal to $D^{2.75}$. The D'Arcy formula in like comparison becomes $D^{2.5} \times \sqrt{\frac{D}{D+1}}$ or $D^{2.625}$.

The changing of the formulas for the flow of water to apply to the flow of steam may be made on the general assumption that the friction and consequent velocity is proportional to the square root of the density of the fluid. This may be held to be substantially correct as between

made to apply to direct radiating surface. This gives in comparison with the older formulas before mentioned:

$R = D \times 100$. Not figured for drop.

$R = D^{2.5} \times 56$. Weisbach. One ounce drop.

$R = D^{2.5} \times 64\sqrt{\frac{D}{D+1}}$ or

$R = D^{2.625} \times 45$. D'Arcy. One ounce drop.

$R = D^{2.5} \times 87\sqrt{\frac{D}{D+3.6}}$ or

$R = D^{2.75} \times 40$. Unwin. One ounce drop.

$R = D^{2.875} \times 30$. Kutter. One ounce drop.

$R = D^{3} \times 25$. Blackmore. Not figured for drop.

VELOCITY OF FLOW IN STEAM MAINS—VARIOUS FORMULAS

	$D^2\times100$	$D^{2.5}\times56$	D'Arcy	Unwin	Kutter	$D^3\times25$	$D^3\times30$
1 inch.....	40	22.6	18.1	15.8	12.	10.	12.
1¼ inches....	40	25.2	21.4	18.5	14.8	12.5	15.
1½ "	40	27.6	24.3	22.5	17.5	15.	18.
2 "	40	31.9	29.4	29.	21.8	20.	24.
2½ "	40	35.7	35.	34.5	27.	25.	30.
3 "	40	39.1	38.6	40.	31.6	30.	36.
3½ "	40	42.2	41.7	43.4	35.6	35.	42.
4 "	40	45.2	45.6	49.	39.8	40.	48.
4½ "	40	47.9	48.6	54.8	43.8	45.	54.
5 "	40	50.5	52.4	58.	47.8	50.	60.
6 "	40	55.3	58.2	66.	55.	60	72.
7 "	40	59.7	63.3	74.3	61.7	70.	84.
8 "	40	63.9	68.4	80.	68.1	80.	96.
9 "	40	67.8	72.6	87.4	74.7	90.	108.
10 "	40	71.4	77.4	92.	81.	100.	120.
12 "	40	78.3	85.4	103.	93.4	120.	144.
14 "	40	84.5	93.4	113.	105.	140.	168.
16 "	40	90.4	99.5	123.	116.8	160.	192.

$R = D^3\times30$. Still. One ounce drop.

The authority, if any, for the drop as given by Still is not known.

The comparative results of these formulas is also given in the tables and diagrams for both velocity and quantity.

Many other formulas for the flow of water have exponents of the diameter very similar to these, such as Hagen, $D^{2.58}$, Thrupp, $D^{2.61}$, Vallot, $D^{2.66}$.

A formula for the flow of air by Frank Richards giving comparative results substantially the same as the Unwin has been very widely used. The Unwin formula for steam has been used by Carpenter and Wolf and the D'Arcy formula by the Armour Institute of Technology for figuring steam main sizes.

There is one other subject that might profitably be taken up in relation to the sizes of steam mains. The relation between the velocity of the flow of the steam and the possibility of proper drainage of condensation has not received the attention that it should in order to obtain a proper proportioning of steam main sizes.

In one pipe steam radiator connections it has been observed that the condensation will not run in opposition to the steam flow if the velocity is over ten to fifteen feet per second in pipes from 1¼ to 2 inches in diameter. Drop feed steam risers and mains in which the condensation runs with the steam are much better practice than up-feed risers and counterflow mains; not so much from the fact that the water helps the steam flow as that the steam helps the water to the drip point.

In up-feed steam risers there is a limit to the velocity which will allow the condensation to flow back down the pipe. If this velocity is exceeded the friction of the steam on the water becomes greater than the force of gravity acting on the water and the condensation is carried upward.

In the case of drops of water not in contact with the interior of the pipe this formula becomes substantially $V = 100\sqrt{D}$. In which V is velocity in feet per second and D is diameter in inches. This gives a velocity of 50 feet per second for drops ¼ of an inch in diameter, which is practically the size of drops falling from ordinary surfaces in still air. Where there is a

CARRYING CAPACITY OF STEAM MAINS—VARIOUS FORMULAS

	$D^2\times100$	$D^{2.5}\times56$	D'Arcy	Unwin	Kutter	$D^3\times25$	$D^3\times30$
1 inch.....	100	56	45	40	30	25	30
1¼ inches...	156	98	83	75	58	49	58
1½ " ...	225	154	136	126	98	84	101
2 " ...	400	317	294	286	218	200	240
2½ " ...	625	543	532	535	410	390	468
3 " ...	900	872	861	890	705	675	810
3½ " ...	1225	1282	1269	1360	1082	1072	1284
4 " ...	1600	1808	1824	1950	1592	1600	1920
4½ " ...	2025	2424	2460	2747	2216	1278	2733
5 " ...	2500	3130	3250	3600	2963	3175	3750
6 " ...	3600	4944	5203	5900	4917	5400	6480
7 " ...	4900	7194	7628	9040	7435	8575	10290
8 " ...	6400	10160	10876	12700	10828	12800	15360
9 " ...	8100	13730	14700	17600	15126	18225	21870
10 " ...	10000	17700	19195	22900	20088	25000	30000
12 " ...	14400	28031	30573	37000	33437	43200	51840
14 " ...	19600	41153	45485	55300	51135	68600	82320
16 " ...	25600	57494	63282	78300	74285	102400	122880

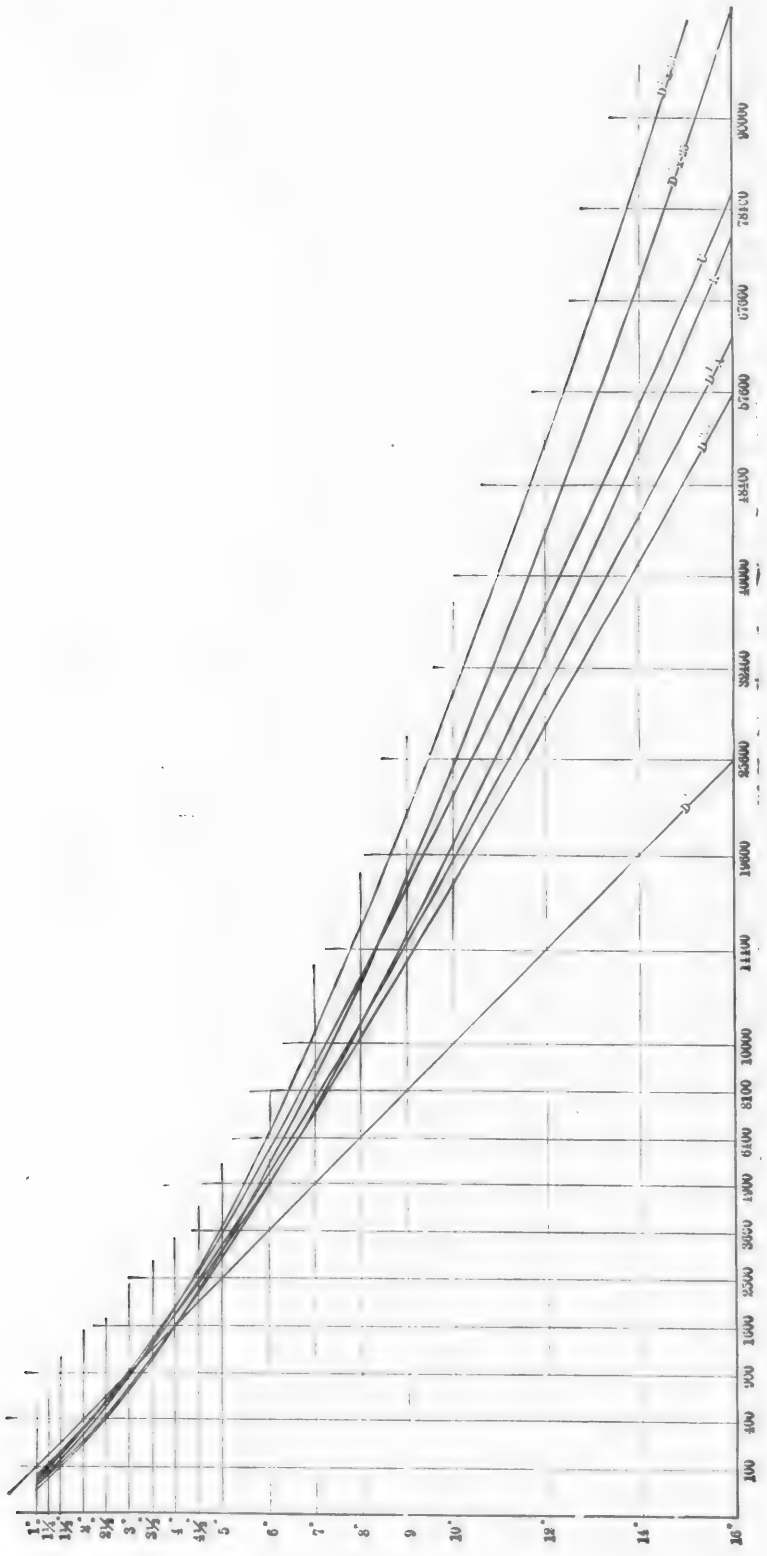


CHART SHOWING CARRYING CAPACITY OF STEAM MAINS WITH VARIOUS FORMULAS.—DIRECT RADIATING SURFACE

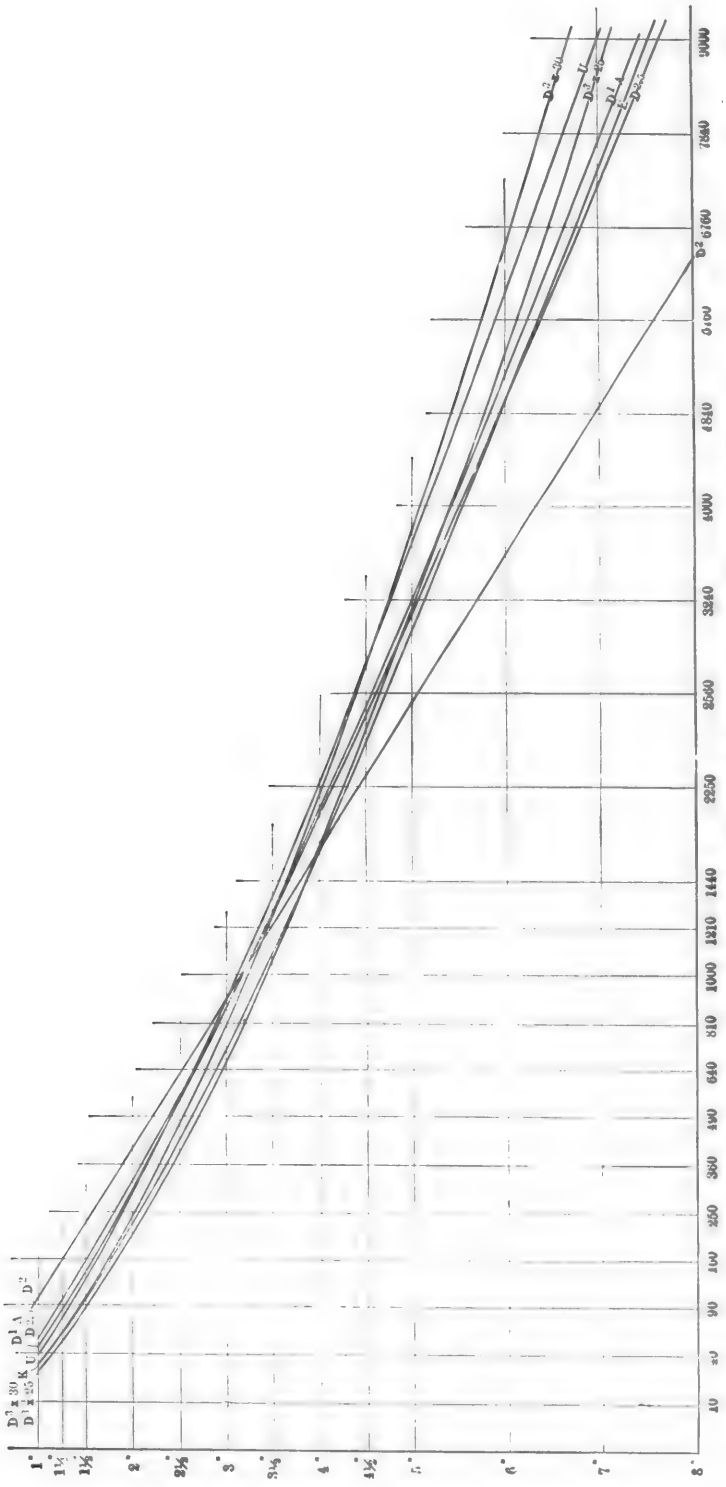
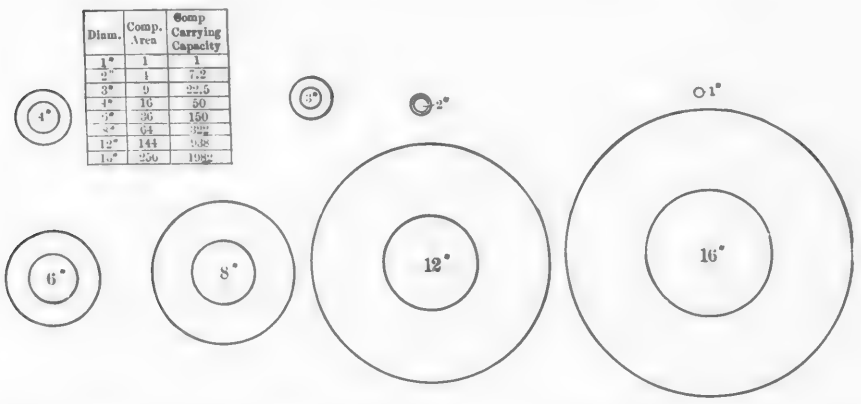


CHART SHOWING CARRYING CAPACITY OF STEAM MAINS WITH VARIOUS FORMULAS—DIRECT RADIATING SURFACE



SKETCH SHOWING COMPARISON BETWEEN AREAS AND COMPARATIVE CARRYING CAPACITIES OF PIPES

current of air or steam, or where the contact point is quite small the drops will be smaller. If they are 1-16 of an inch in diameter the velocity becomes 25 feet per second.

There does not seem to be anv data available as a guide for figuring the velocity which would carry up water that was in contact with the side of the pipe, but it would probably be very much the same as for drops not in contact with the side.

It is very evident in many cases that the greater part of the water that is removed by the drip of the exhaust head is that which is carried up by the steam, and that a much less amount would be present were the velocity sufficiently flow to allow it to drip back against the flow of the steam.

It has been noted and commented upon that the water of condensation in a horizontal steam pipe does not lie at all uniformly along the bottom of the pipe, but that it clings to the sides as well. This is probably caused to a great extent by too high a velocity.

It would seem as if a series of experiments on velocity and drainage of condensation in steam mains would be of great value to heating engineers.

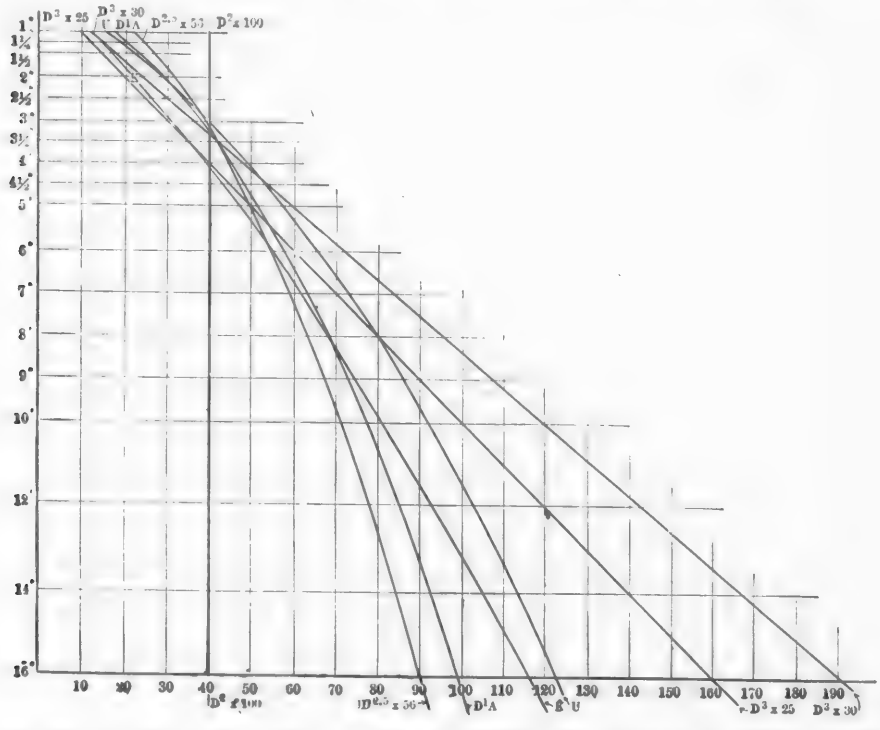


CHART SHOWING VELOCITY OF FLOW IN FEET PER SECOND IN STEAM MAINS WITH VARIOUS FORMULAS

Points on the Design of a High-Pressure Superheated Steam Heating System, Combined With a Light and Power Plant

(Based on European Practice)

By Frank Koester

The use of high pressure for transmission of steam from a central station to a number of buildings is not a new idea, but has been employed to a small extent, only; still less has been done in combining the heating system to a generating plant, supplying light and power to the buildings to be heated.

The combination of both will, of course, prove of greater advantage the more buildings that are supplied with light, heat and power. The advantage of such a system is more apparent where buildings are grouped over a small area, as is often the case in Government, State and municipal buildings and business districts. One of the most important advantages is the reduction of fire risk, as they would have no local furnaces; this is an important factor in theaters, museums, institutes, lecture halls, etc.

For distributing the steam over a wide area a pressure of from 80 to 125 pounds to the square inch should be employed; this will reduce the size of piping and also reduce the condensation in the main over that of a low pressure system. Still better results will be obtained in these respects in the employment of superheated steam for distributing. The pressure and amount of superheated steam is dependent upon the length of the distributing main.

Although the use of superheated steam in power stations is established, its use in heating systems has not been developed in this country to the extent that it has in Europe, particularly on the Continent, where it had its birth. The benefit of superheated steam lies practically only in its transmission.

The writer, in the following, will endeavor to outline briefly some of the most important points, as employed in European practice, to be taken into consideration in designing such a light, heat and power transmission system.

LOCATION OF PLANT AND CHOICE OF BOILERS

The power station should be located as near the center of distribution as possible, with regard, however, for tide water and railroad to facilitate the handling of coal and ashes, and with regard, also, to a convenient supply of condenser water. The foregoing may, however, be disregarded to some extent, if it is found advisable to locate the station at the lowest point, so as to drain the water of condensation from all buildings supplied by gravity back to the boiler room.

The size of the plant should be determined by the amount of radiation and current necessary to supply the various buildings with sufficient space for a future extension.

In choosing the boiler a quick steamer with a large water capacity is required, so as to meet any sudden increase in load, without considerable drop in pressure. The boilers should be equipped with superheaters to supply a temperature of at least 100 degrees to 150 degrees Fahr. dependent upon the length of transmission line and the type of prime movers installed in the generating station. The superheaters should be installed in the boiler setting. Where the pressure used in the generating plant is in excess of that desired on the distributing main, pressure reducing valves can be installed to reduce to desired pressure.

SUPERHEATED STEAM FOR HEATING SYSTEM

As superheated steam is used in the prime movers, it is only logical that it should also be used in the heating system, as thereby we eliminate the necessity of a double system of boiler-room piping, besides the

above-mentioned advantages. This will especially refer to the operation of the plant when one has to employ unskilled labor as a single pipe system is more conveniently operated. Other considerations are, the first cost, the fewer valves and fittings, and the decreased liability of a breakdown.

With the use of superheated steam, the size of the pipe could be reduced over that of a saturated system, where a velocity of 6,000 and 7,000 feet is employed, whereas in the former case velocities from 9,000 to 10,000 feet and higher may be reached, dependent, of course, on the amount of superheat employed.

As a factor of safety, some European plants employ a double pipe system for transmission, one pipe being held in reserve and used only in case of a breakdown. In some cases where first cost is a factor, the reserve line is made smaller than the other pipe. When, however, more than one tunnel has to be provided, these tunnels may be so inter-connected as to form a ring system, and a single pipe main will answer the above purpose. Where a single pipe has been installed for a certain number of buildings, and new buildings are added, they can be supplied by increasing the pressure.

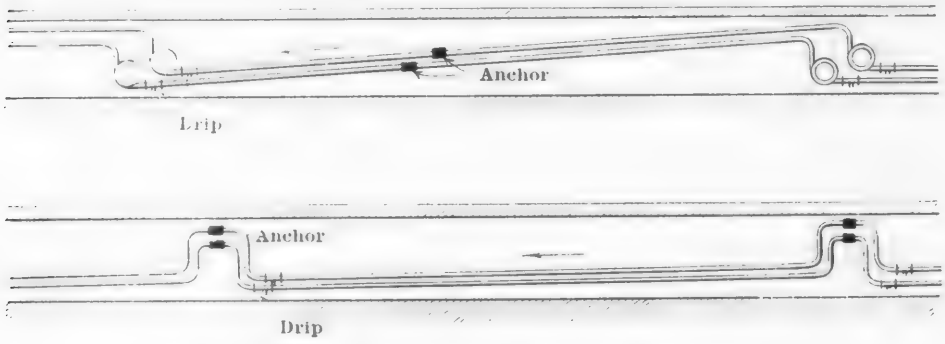
First-class fittings should be employed. Valves capable of withstanding superheated steam are easily obtainable.

EFFECT OF LIGHTING SYSTEMS ON BOILER LOAD

If direct or alternating current should be used in the lighting system, it depends largely upon the distance it is to be transmitted; that is, if the additional copper for the direct-current system is less than the cost of the transformers or converters required, a direct-current system may be advantageously installed. By using direct-current system a storage battery may be successfully employed to take care of any great fluctuation of load, as in the morning a maximum amount of steam is required for heat, while a minimum amount is required for light, these conditions are absolutely reversed in the evening. This question should be thoroughly investigated, before decision is made.

METHODS OF RUNNING STEAM MAINS

One of the most important factors in a plant of this kind is the manner in which the steam mains are run, whether in tunnel, trench or merely buried. If the system is an elaborate one, the mains should be run in a tunnel, which will also carry cables. This tunnel should be at least six feet wide and eight feet high, with the steam piping arranged on one side and the cables on the other.



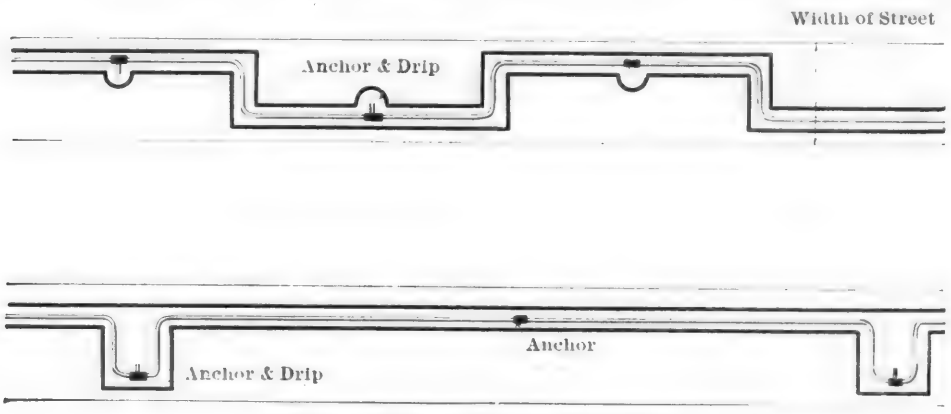
FIGS. 1 AND 2.—LONGITUDINAL SECTIONS OF TUNNELS

Figs. 1 and 2 illustrate the method of taking up expansion of pipes arranged in a tunnel, the pipes being laid against the wall. In Fig. 1, a method is shown in which the pipes rising from the floor to the ceiling by means of 90 degree bends, or spiral loops, and pitch gradually in the direction of the floor, at which point a drip is provided and connected to the main drip line flowing to the boiler room, the main thus forming a saw-tooth appearance in elevation.

In Fig. 2, the pipes are bent in long loops from the floor to the ceiling

at regular intervals and drip similarly to the method shown in Fig. 1. In both systems, the pipes are anchored midway between expansion loops.

A cheaper, but less convenient, system is to place the pipes in a trench and run the cables in a separate duct system. By employing this system it is difficult to locate leakage and, usually, large sections of the street have to be opened. In order to take up the expansion in the steam mains, it is a good scheme to run the trench from one side of the street to the other at stated distances, in order that the mains will have long flexible bends, as will be seen in Figs. 3 and 4. Proper anchors should be provided and so located that the trust on the bends will be equally



FIGS. 3 AND 4.—PLANS OF TRENCHES

divided. These expansion bends should be made of the same material as the rest of the main. Copper should be avoided, as copper is not suitable to superheated steam of high temperature.

SLIP EXPANSION JOINTS NOT SUITABLE

Under no circumstances should slip expansion joints be used, as they are a continuous source of annoyance, due to leakage and, if a line has been shut down for any length of time, are liable to "freeze." Repacking is often neglected and the joint is therely liable to jam, which would result in the breaking of fittings or straining of pipes when steam is again turned on a line which has been cold, as there is no way to take up the expansion.

Proper supports, either brackets or hangers, should be provided. These should be either of the roller or ball-bearing type, the latter being so arranged that the pipe may move in any horizontal plane and they are, therefore, suitable for that position of pipe located near the expansion pieces.

PIPE COVERINGS

Another important factor is the pipe covering. This may be made of various materials, but it is economy to use the best heat non-conductor obtainable; a good covering which will so protect a steam pipe that there will be 85 per cent. less condensation than would obtain if the pipes were bare. This is secured in American practice by using a covering containing 85 per cent. of magnesia with an asbestos band. On the continent of Europe, Kieselguhr (an earthy substance) is applied and the same results obtained, while still another system, which has been successfully applied in a high pressure steam heating system in Dresden, the most prominent system in Germany, is that of air jacketing the pipe by placing a sheet of perforated galvanized iron furred out from the pipe, which is covered with raw silk, over which a similar iron cover also furred out from the second cover is placed, and this also covered with raw silk, thus forming two complete air jackets.

All pipe flanges should be provided with a removable covering. The fewer joints the cheaper the mains and the less chance for leakage, and

as a matter of interest, it may be stated here that pipes of 50-foot lengths are obtainable in Europe, without special order.

HIGH TEMPERATURE IN TUNNEL NECESSARY

The temperature in the tunnel should be kept as high as is possible, with a good covering this temperature would not amount to over 100 degrees Fahr., with an average winter temperature. There should be as few openings as possible to prevent air currents, as the surrounding temperatures will effect the condensation in the pipes. The radiation through walls, floor and roof of the tunnel will increase the condensation from 5 per cent. to 10 per cent., dependent upon the outside temperature, providing that the construction of the tunnel itself is a good heat non-conductor, and as water tight as possible. It will, therefore, be seen that a cheaper covering of say 70 per cent. will materially increase the radiation of the tunnel itself.

TUNNELS SHOULD BE DRAINED

Proper means should be supplied for drainage, as the construction cannot be entirely water proof. Sumps should be provided at the low points for collecting the seepage; also, provision should be made for a drip line, draining the steam main and the water of condensation to the boiler room either by gravity, or, if necessary, by means of pump and governor.

The tunnel itself should be sufficiently supplied with electric lights, which might be arranged in sections, so that each section may be operated independently, which will facilitate inspection and repairs.

REDUCING VALVES FOR BRANCH MAINS

In each of the various branch mains, supplying buildings, reducing valves should be installed to reduce pressure to that required for heating. If a pressure of over 100 pounds is carried in the main, it is advisable to place two reducing valves in the branch mains, one to reduce to 75 pounds and the other to reduce to the desired heating pressure.

The Effect of Air Leakage upon Ventilation

There is little difficulty in forcing 4,000 cubic feet of air per minute with a plenum fan into an ordinary schoolroom when the outlet is closed and windows and doors made as tight as practicable, and hardly a perceptible rise in the barometer can be noted. This will show the effect of leakage.

In some cases, especially where fans or blowers are used, as in the plenum system, to force air into a schoolroom, and where the exhaust is very deficient, there is a tendency to force the air out of the room as it falls on the cool walls and also through the ceiling. As the warm air goes directly to the top of the room and at least three-quarters of the leakage is above the breathing plane, a large quantity of the fresh air will not reach the pupils.

As the result of many observations the writer is led to believe that a schoolroom supplied with 1,500 cubic feet of air per minute, with properly located fresh warm-air inlets and foul-air vent flues, will have the air at the breathing plane kept as pure as it will when supplied with 2,500 cubic feet per minute with no proper provisions for circulating and removing the air.

The nominating committee placed the following ticket in the field, The result of the voting is ascertained and announced on the opening night of the meeting.

President, Reginald Pelham Bolton, New York; C. B. J. Snyder, New York.

First Vice-president, James Mackay, Chicago; T. J. Waters, Chicago.

Second Vice-president, Wm. G. Snow, Boston, Mass.; Jas. D. Hoffman, Lafayette, Ind.

Secretary, Wm. M. Mackay, New York; Thomas Barwick, New York.

Treasurer, U. G. Scollay, Brooklyn, N. Y.; Frank P. Blodgett, Brooklyn, N. Y.

Board of Governors, R. C. Carpenter, Ithaca, N. Y.; Robt. E. Atkinson, Leicester, England; Frank K. Chew, New York; Edmund F. Capron, Chicago, Ill.; B. F. Stangland, New York; Albert B. Franklin, Boston, Mass.; John F. Hale, Chicago, Ill.; B. H. Carpenter, Wilkesbarre, Pa.; A. M. Feldman, New York; Wm. H. McKiever, New York.

THE HEATING AND VENTILATING MAGAZINE

PUBLISHED MONTHLY AT
1123 BROADWAY, NEW YORK
BY THE
HEATING AND VENTILATING MAGAZINE CO.

A. S. ARMAGNAC, EDITOR

European Representative:
AMERICAN PUBLICATION BUREAU, 31, Overton Road, Leicester, England

Subscription, - - - - - $1.00 per year
Foreign countries, - - - - 1.50 " "

Manuscripts submitted for publication must in every case be accompanied by postage; otherwise they will not be returned.

THE experience of various committees, representing both technical and commercial associations, engaged in the collection of data of one sort or another during the past year, have, as a rule, been such that many will doubt whether undertakings of this character are practicable in these days unless substantial appropriations go with them. This point is emphasized when it is considered that considerable information along one line of inquiry could not be obtained by the committee itself, but appeared, nevertheless, in print at a later date. Such instances are not peculiar to any one association, nor is there necessarily a mercenary motive attached. It simply means that a request for definite information with the understanding that payment is to be made for same has more weight than a similar request with no offer of payment. Moreover, rather than present a barren report to their society, the members of such committees very frequently go to considerable trouble and expense in securing data which experience has shown is not hard to obtain for a consideration. There is, too, in the case of a committee working with an appropriation the opportunity for doing some independent investigation without feeling that the time expended is an encroachment without immediate return on the time required for other business.

IN addition to an interesting programme, a feature of the forthcoming meeting of the American Society of Heating and Ventilating Engineers will establish a commendable precedent, in proper keeping with the satisfactory advance the society is making, both in point of membership and influence. We refer to the participation of the ladies in the social features of the programme. An immediate result of this action was the chartering of a special car, by the Illinois members, to convey their party to New York, thus combining a pleasure trip with what would otherwise have been mainly a business trip to the metropolis.

A NOTABLE feature of the weather charts for December, to be found on another page, is that showing the lack of snow in all cities from which reports were received, excepting Boston, where there was, during the month, a total snowfall of 15 inches. Yet at the end of the month, there was no snow on the ground. Bare ground at the end of the month was also reported from New York, St. Louis, Pittsburg and Chicago.

The effect of melting snow in the heating of buildings is a matter of importance and may be traced to a degree by noting the course of the humidity line simultaneously with that of the temperature line when the lat-

ter is above freezing point. Yet thus far during the winter, little or no opportunity has been afforded to note this effect.

IN connection with the weather, many of our readers will be interested in a recent discussion of the subject from a scientific point of view before the Franklin Institute, in Philadelphia, by Professor Albert J. Henry, of the United States Weather Bureau, at Washington. Professor Henry said that modern weather forecasting is based on two well-established facts, (1) the general eastward drift of the atmosphere in temperate latitudes in the northern hemisphere, and (2) the close relation that exists between the weather and the distribution of atmospheric pressure. In explaining the terms "high pressure" or "areas of high pressure" and "low pressure" or "areas of low pressure," the speaker said that if the distribution of atmospheric pressure on a certain day could be accurately foreseen, a forecast of the weather would follow quite easily, as the state of the weather at any point depends more upon the position of these travelling areas of high pressure and low pressure with respect to each other, than upon the actual reading of the barometer at that point.

Thus it has been found that in the eastern part of the United States, precipitation will begin with the barometer at 30.50 inches, provided the area of high pressure is to the northeastward of the area of low pressure. On the other hand, precipitation seldom or never occurs in the eastern part of the United States, no matter what the barometer reading is, provided the area of high pressure is to the westward, say over the Ohio Valley, and the area of low pressure is passing off to sea along the Middle Atlantic coast.

ANOTHER interesting point brought out by Professor Henry was the varying directions of the wind during the passage of a storm. The wind does not blow directly towards the center of a storm but blows spirally about it, forming, as it were, a huge whirlpool of air. Thus in a storm which, we will say, is central over Kansas, the wind in the southeast will have a general southerly direction. In the northeast, easterly winds will prevail, while in the northwest and southwest, the winds are mostly northwest to west. An observer stationed in Detroit, for instance, will have fresh easterly winds, shifting as the storm center approaches him around to the south by way of southeast and as the center passes him, shifting still further to the west or northwest. These phenomena explain why most storms in the vicinity of New York, though approaching from the west, are so often accompanied by easterly winds.

THE new Hippodrome Building in Cleveland, Ohio, contains one of the largest auditoriums in the world. The mechanical ventilation of so large a space, in itself an interesting problem, becomes especially so in view of the fact that a down draft system was used. In the article on another page describing the heating and ventilation of this auditorium, the illustrations show in great detail the working out of the scheme of ventilation. The plant, we may add, has been described as one of the best recent examples of downward ventilation.

Oily Waters and Their Treatment*

By Albert A. Cary

The separation of oil from exhaust steam or from the water resulting from its condensation is a matter of great interest to all engineers, and so disastrous have been the results in many cases by using such water in boilers that to-day we find in many large plants the water from this condensed steam wasted, no attempt being made to return it to the boiler. In plants where the cost of city water runs from ten cents upward per thousand cubic feet such waste means a very considerable loss, owing to the fact that fresh water from the city main has to be constantly supplied to the boilers, whereas, if the condensed steam from the engine could be used, the cost of water for use in the boiler would be very materially lessened.

(Mr. Cary proceeded to discuss the many different kinds of cylinder oil.)

With these remarks concerning the various conditions in which we find oil in exhaust steam we may look to the various methods of separating it, first, from the steam, and second, from the water of condensation (previous attempts to rob the steam of its oil not being considered in this latter case).

METHODS OF OIL SEPARATION.

The various methods of oil separation from steam may be classified under the following headings: Steam filtrations; steam washing; precipitation by gravity, for which purpose the velocity of the steam must be considerably reduced for a short period of time during its flow; separation by use of oil catchers, which consists of specially prepared surfaces, such as baffle plates with corrugations or other irregular faces, also by use of wire screens placed in the path of the flowing steam, or by passing the steam through a chamber filled with suspended chains; precipitation of oil upon the surface of water; separation by passing the oily steam through a material which has a greater affinity for oil than exists between a surface of water and the oil.

The various methods of the separation of oil from the water resulting from the condensation of steam may be classified under the following headings: Skimming; filtration; treatment with chemicals and coagulants followed by filtering; use of oil absorbents mixed with the water.

Considering this subject under the various headings given above, we first have:

STEAM FILTRATION.

There have been many attempts to remove oil from exhaust steam by steam filters. We find a very large variety of material used for a filtering medium, such as blankets, sponges, coke, hay and excelsior. These are enclosed in a long circular or rectangular box. Fig. 1, which is fitted with baffle plates to force the steam to travel over and under the various baffles from one end of the box to the other and when such filters are kept clean very fair results may be obtained, but as the filter gradually becomes fouled with the oil less and less oil is retained, and either the filter becomes clogged so as to cause a back pressure on the engine or else allowing the passage of large amounts of oil.

When blankets and sponges are used, these are taken out periodically and put through a cleansing process in a caustic solution. Attempts have been made to clean oil-charged hay and excelsior by forcing a current of hot water through the filter in a reverse direction to that taken by the flowing steam, and when coke is employed, a very open and porous coke

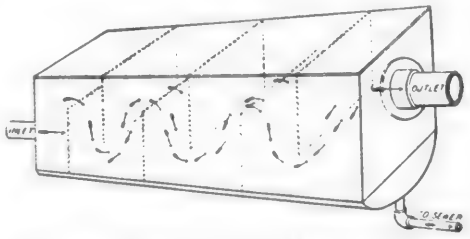


FIG. 1.—COKE-FILLED STEAM FILTER

must be used, such as can be obtained from gas houses, and after this becomes clogged it is the usual practice to shovel it out of the filter and burn it under the boilers, replacing it with a supply of fresh coke.

By the methods of filtration described above it will be seen that the small globules of oil and also the drops of water carrying oil will have their passage retarded when the filter is in good condition, but the oil vapor, even under most favorable conditions, is very apt to pass through the filters and continue on into the boiler.

STEAM WASHERS.

Steam washers have been used for the separation of oil from steam with fairly good success in some plants. These washers, Fig. 2, consist of a vertical cylindrical tank having three chambers, the top chamber resting like a hat over the top of a tube plate. The tube plate, separating the top chamber from the central chamber, contains tubes which drop to within a short distance from the bottom of the central chamber and the lower open ends of these tubes are immersed in water carried in the bottom of the central chamber, so that the steam when exhausted into the upper chamber is obliged to pass down-

*From a paper read before the American Society of Refrigerating Engineers, December 3rd and 4th, 1906.

ward through the vertical tubes and then through the water in which they are submerged; the steam then bubbles upward through this water into the top of the central chamber, from whence it passes out to the condenser. The bottom of the central chamber also consists of a tube-plate with the tubes extended upward to the surface of the water contained in the central

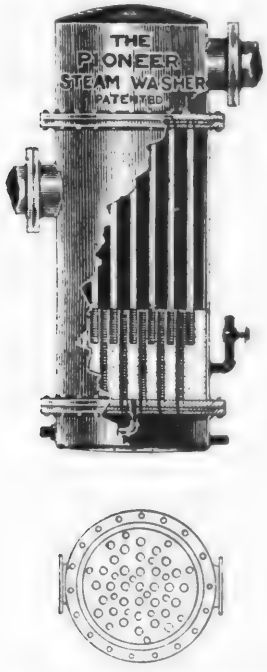


FIG. 2.—STEAM WASHER

chamber, and as fast as the condensed oily steam accumulates in this central chamber it overflows, passing downward through the short vertical pipes into the bottom chamber, from whence it is run off. By the use of such a device, the vapor, as well as the small particles of oil and water globules covered with oil, are all forced to pass through the body of water, and, providing this water is sufficiently cool and if it has a sufficient volume and ample circulation of the wash water occurs, very good results have been obtained.

PRECIPITATION BY GRAVITY.

This class of separator has not proved as efficient as some of the other forms mentioned. Its principle of working depends upon the reduction of velocity, or sudden change in the direction of flowing steam. Thus we find in certain oil separators of this type that the steam flowing along a pipe of proper dimension is suddenly discharged into a pipe or tank of very much larger area, where its velocity of flow is suddenly diminished. This reduction in speed of steam flow causes the suspended particles of oil and water to drop to the bottom of the large pipe or tank, the same as suspended particles of sand or dirt are precipitated from the water of rapid-flowing brooks or rivers when it suddenly rushes into a large basin along their course. Other separators of this type not only supply this enlarged chamber along the line of steam piping, but they also provide for sudden changes in the direction of the flow of the steam. These changes in the direction of steam flow also cause a difference in velocity, followed by a precipitation of suspended particles, the same as before described.

Special arrangements are usually provided for entrapping the dropping suspended particles which are usually discharged by gravity through a steam trap arrangement.

It will be seen that this class of separator can only care for the particles of solid oil, water, and oil-coated globules of water, while much of the oil in vapor form will pass through the apparatus and cause trouble beyond.

OIL CATCHERS.

I am afraid I cannot endorse oil catchers very highly, as my experience has not shown me very satisfactory results by their use. When some of these devices are perfectly clean and in good working order I have seen some excellent results obtained by their use, but after they commence to get foul, the oil seems to pass over their surfaces and accompanies the outgoing steam. In these separators we find box-shaped castings having irregular surfaces, against which the steam is projected from the inlet pipe, the idea being when the steam once reaches such surfaces, owing

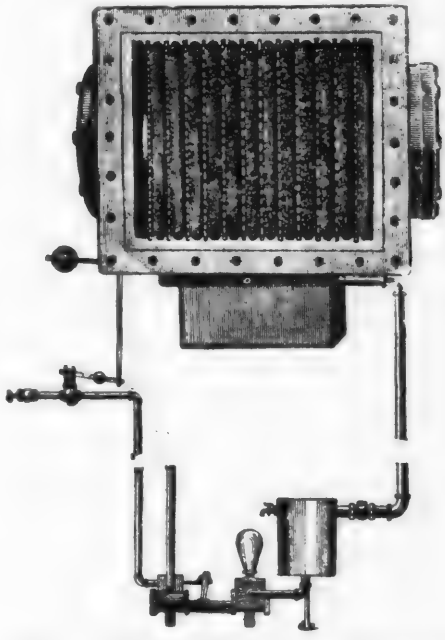


FIG. 3.—INTERCEPTING OIL SEPARATOR

to its sticky nature, it will attach itself to them and run down their corrugations or along other irregular surfaces into channels which are prepared to allow the water and oil to flow. In nearly all of these devices, we find the area provided for the steam flow much larger than the feeding steam pipe, for the purpose of allowing the heavier drops of water and oil to fall by gravitation from the steam which carries them.

In another form of this class of apparatus, we find box-shaped castings containing wire cloth, Fig. 3, generally of three or four different mesh, through which the steam is blown, and such devices depend upon the velocity of the steam passing through their enlarged areas, as well as the considerable surface presented to the exhaust steam by the wire forming the screens, on which the sticky oil is supposed to collect, and then work its way downward to the bottom of the trap from whence it is discharged. In the upper cover of the trap in this device is a removable hood or cap which can be easily taken off and the various screens removed and cleaned, and thus very good provision is made in keeping these surfaces in an effective condition.

SUSPENDED CHAINS.

The steam traps containing suspended chains which hang from their upper surfaces work in a similar manner to the trap just described containing wire screens.

PRECIPITATION OF OIL ON THE SURFACE OF WATER.

We now come to the matter of the precipitation of oil on the surface of water, which is very effective under proper working conditions. In this device, Fig. 4, we have what might be considered a small cylindrical boiler without tubes, placed horizontally, which is constantly kept about one-third full of cool water. The steam from the engine enters the top of this cylinder and is projected upon the surface of the water immediately below it. I have already spoken of the tenacity with which the oil clings to the surface of the water and advantage is taken of this fact in the design of this apparatus. The small particles of oil, the water particle surrounded by its envelope of oil and the vapor are all thrown against the surface of this water by the entering force of exhaust steam and, as the cylinder is very much larger, in cross-sectional area than the steam pipe, the exhaust steam has an opportunity to easily drop any of its suspended matter upon the surface of the water. The steam entering the tank from the top at one end leaves the tank at the opposite upper end and, by this arrangement, it has every opportunity offered for getting rid of its charge of oil.

A grating placed at the level of the surface of the water immediately below the inlet steam pipe is found to increase the efficiency of this apparatus, as without this grating the oil film and water at this position is agitated too vigorously to allow the oil to collect there.

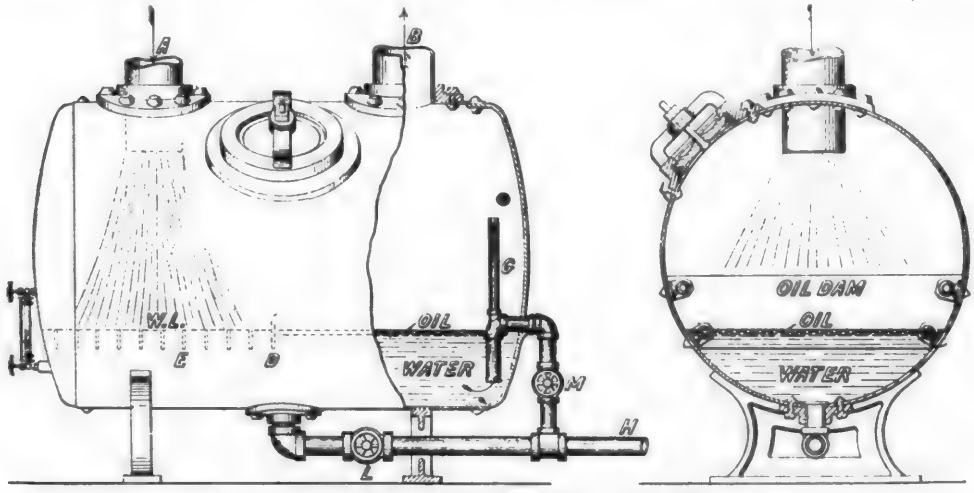


FIG. 4.—WATER SURFACE OIL SEPARATOR

SEPARATION BY PASSING THE OIL IN STEAM THROUGH AN OIL ABSORBING MATERIAL.

Considering now the last classification of oil separation from steam, this is an entirely new method of treatment, which may only be said to have passed the experimental stage. I have found it to be a wonderful absorber of all kinds of oil, having a greater affinity for oil than even the surface of the water. It is an inexpensive mineral substance and when reduced to a sandlike size and form, the exhaust steam, when blown through it, will lose its contained oil, which leaves the steam and attaches itself to the material. The material may be either dry or mixed with water, so as to be used in a steam washer, and its capacity for oil is very great.

I think I have now considered all the different methods in use on the separation of oil from exhaust steam, but we find, in most plants, that no provision of this kind has been made to rob the steam of its oil, so the oil is allowed to pass through the condenser, and the resulting water flows on to the hot well.

As oily steam passes from the engine into the condenser, much of the vaporous oil unites with the condensing steam and forms an emulsion of oil and water, and as the free oil is carried with the water of condensation and discharged in a more or less head, into the hot well this agitated oil and water tend to unite still further in an emulsified condition, the same as the water and oil in the shaken bottle, referred to earlier in this paper.

SKIMMING

Referring now to the first method of separation of oil from water, namely skimming, I will describe an apparatus designed by me a number of years ago to operate upon this principle. Referring to Fig. 5, it will be seen that the hot well consists of a tank with a central wall dividing it into two compartments. The water of condensation is delivered into the left chamber, flowing gently from the delivery pipe over a metal cone which prevents the incoming water from striking violently upon the surface of the tank water, which would cause further emulsification. The water thus introduced slides gently over the cone to the surface of the

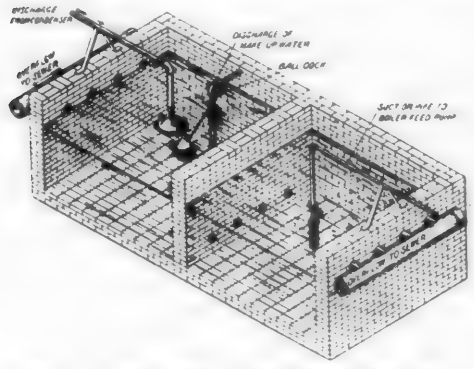


FIG. 5.—HOT-WELL ARRANGED AS OIL SKIMMING TANK

tank water and thus facilitates the floatation of the free oil and oil-coated particles of water.

At the extreme left of the left-hand division of the hot well will be seen a large number of large earthenware pipes through which a constant overflow of water from the surface of this well took place, carrying with it the oil which floated there. The balance of the condensed water then passed downward through a number of openings in the lower part of the central wall of the tank into the left-hand division, from whence it was also allowed to overflow through sewer pipe connections, as some little oil was found to gather there upon the surface of the water in this second chamber. The end of the suction pipe to the boiler pump was placed near the bottom of this left-hand tank and equipped with a strainer. When in operation this apparatus worked fairly satisfactory, but at times considerable oil would pass through the tanks to the boiler.

I might add that a ball cock regulated the flow of fresh water into this skimming tank and always kept the water level up

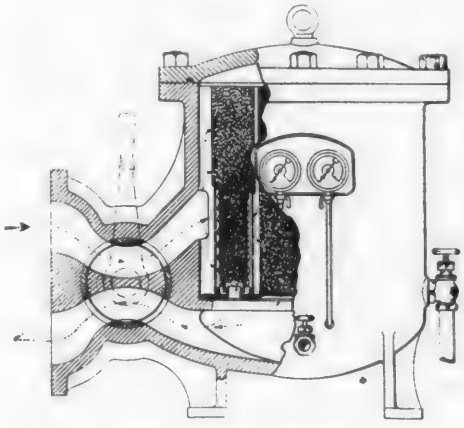


FIG. 6.—OIL FILTER

Upper Opening Leads from Feed Pump. Lower Opening Connects with Boilers

to a point where the water would constantly run off slowly through the sewer pipe connection shown.

FILTERING HOT WELL WATER

We next come to the matter of filtering hot well water, which is a very satisfactory method of getting rid of the oil, although I know of a few plants where they claim to get fairly good results by this means. This practice is largely followed at sea and the materials used at filtering mediums are the same as those described above for filtering oily steam, to which list I might add sand filter beds.

Cleaning such filters is, at the best, a filthy job, which will be avoided by those to whom this duty falls as much as possible, If such filters are not kept clean, they become worse than useless, as when anyone has a preventive of any ill in operation in their plant, they will depend upon their successful operation beyond all reasonable time.

One of the best forms of this class of filters is shown in Fig. 6, which consists of a cylindrical shell filled with a number of so-called cartridges, which are interchangeable and easily removed and replaced. These cartridges are cylinders, of perforated metal with an opening at their bottom end. A cloth stocking-like envelope is pulled over the outside of the perforated cylinders, acting as the first

filtering medium, while the interior of the cylinder is filled with a fibrous material, which also acts as a filter.

The oily water is sent from the condenser into a closed chamber containing these cartridges, and after passing through the double filter, the remaining clarified water is discharged through the bottom opening of the cartridges into a receding vessel forming the bottom of the apparatus.

CHEMICALS AND COAGULANTS

The chemical treatment of water for the removal of oil has proved thus far a failure.

The use of coagulants such as alum or aluminum sulphate and green vitriol or sulphate of iron has been tried on a large scale in a number of plants with a fair degree of success.

The great danger connected with the use of these sulphates is due to their reaction in water, which not only forms the flocculent sticky material, but also forms sulphuric acid, which would prove more dangerous in our boilers than oil itself. To neutralize this acid, it is necessary to treat the water with a caustic soda, which results in the formation of sulphate of soda, which remains in solution, unless greatly concentrated, at all ordinary boiler temperatures. This harmful concentration can be avoided by the frequent "blowing off" of the boiler.

THE USE OF OIL ABSORBENTS MIXED WITH THE WATER

My first attention was called to this method of treatment in 1900, by Mr. N. O. Goldsmith, of Cincinnati, and subsequent experiments made along these lines gave me results which were perfect in most cases, but failing to a small extent in other tests.

Mr. Goldsmith employed a process similar to an English invention known as the "Anderson" process for purifying portable water. I do not think that Mr. Anderson ever employed this method for oil elimination.

The material used for absorbing oil from the water was the hydrous oxide of iron ($2\ Fe_2O_3\ 3H_2O$). The principal objection to the use of this process is the necessity to prepare this hydrated ferric oxide in sufficiently large quantities to meet the requirements.

One fortunate fact, in connection with the use of condensed steam, is that there is a very large amount of air present in this water. The presence of this air in condensing plants requires the use of large air pumps.

Atmospheric air contains nitrogen and oxygen in the proportion of about 4 to 1. On account of the greater solubility of oxygen in water, we find the dissolved air in water having a proportion of 1 volume of oxygen to 1 87-100 volumes of nitrogen.

With this increased amount of oxygen we find, with the warmth and moisture present, a very active rusting action taking place when this oxygenated water comes in contact with bright iron chips from lathes, etc. Advantage is taken of this, in this modified "Anderson" process, and the condensed steam, or water, is led into a long, cylindrical, revolving tumbling barrel, filled with bright iron chips, etc. As this iron oxidizes, the revolving tumbling barrel rubs its contents, one piece against the other, and thus throws off the iron oxide, which immediately absorbs the oil present. The bright chips, left behind, quickly oxidize again and thus the process continues.

A little over a year ago I had a new material for oil absorption presented to me for investigation, and found, after very thorough test, that it fulfilled all requirements for this purpose in a most satisfactory manner and I might add that it was the first absolutely satisfactory oil extracting method I have ever found after many years of investigation of such processes.

The material which, as stated before, I cannot describe in detail at this time, is obtained from a natural rock deposit. It is easily obtainable in large quantities and therefore is not expensive. Generally speaking, all that is necessary in treating oily water with this material is a thorough mixing device which will distribute this light feather-like material throughout the water of condensation. All the oil is then found to leave the water and attach itself to this material, which has a very large capacity for oil.

This oil ladened substance is subsequently removed from the water by rapid filtering process, and the resulting water, after proper treatment, by this process, is found to be perfectly clear and free from the taste of oil.

So effective is this material that the quantity used for oil extraction is but one-twentieth of one per cent. of the weight of the water itself, and the material can be used over and over again for a great number of times.

The Weather During December

The following data will supplement the information contained in the accompanying weather charts showing the temperature and other records in the cities of New York, Boston, Pittsburg, Chicago and St. Louis. The month was notable throughout many sections for the absence of any considerable snowfall.

NEW YORK

In New York the highest temperature recorded was 57° on the 15th, and the lowest, 8° on the 24th. The greatest daily range was 40° on the 7th and the least daily range, 4° on the 30th. The mean temperature for the month was 33°, 1 below the average for this month for 30 years. There was 3.53 inches of rain, 0.98 inches falling on the 30th and 31st. There

were 0.5 inches of snow. The prevailing direction of the wind was northwest and the total movement, 10,772 miles; average hourly velocity, 14.5 miles; maximum velocity for 5 minutes, 58 miles per hour from the west on the 7th. There were 6 clear days, 9 days partly cloudy, 16 cloudy and 13 rainy.

CHICAGO

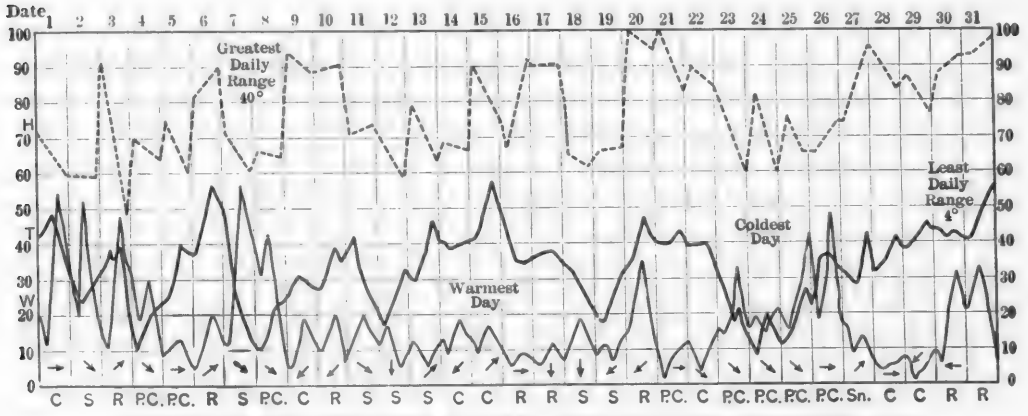
The highest temperature recorded for the month was 56° on the 14th and the lowest, 10° on the 7th. The greatest daily range was 39° on the 6th and the least daily range, 3° on the 27th. The mean temperature for the month was 33°, 4° above the average for 36 years. During the month 2.46 inches of rain fell and 0.3 inches of snow. The greatest amount of rain in any one day was 1.14 on the 5th-6th. The prevailing direction of the wind was northwest; total movement, 11,359 miles; average hourly velocity, 15 miles; maximum velocity for 5 minutes, 39 miles from the southwest on the 31st. There were 3 clear days, 8 partly cloudy, 20 cloudy and 11 rainy.

ST. LOUIS

In St. Louis the highest temperature was 63° on the 5th and the lowest, 10° on the 23d. The greatest daily range was 38° on the 6th and the least daily range, 5° on the 31st. The mean temperature for the month was 37°, 1° above the average for 34 years. The total rainfall was 2.09 inches and the snowfall, 1.6 inches. The greatest rainfall in any one day occurred on the 29th-30th, when 0.61 inches were recorded. The prevailing direction of the wind was southeast; total movement, 8,001 miles; average hourly velocity, 10.8 miles; maximum velocity for 5 minutes, 38 miles per hour from the west on the 6th. There were 4 clear days, 6 partly cloudy, 21 cloudy and 10 rainy.

PITTSBURG

The highest temperature for the month was 61° on the 31st and the lowest, 9° on the 25th. The greatest daily range was 30° on the 6th and the least daily range, 6° on the 9th. The mean temperature for the month was 33°, being 1° below the average for 37 years. There was 2.52 inches of rain and 7.4 inches of snow. The greatest amount of rain in any one day was 0.62 on the 5th-6th. The prevailing direction of the wind was west and the total movement, 8,342 miles; average hourly velocity, 11.2 miles; maximum ve-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Greatest Daily Range 40°
Warmest Day
Coldest Day
Least Daily Range 4°
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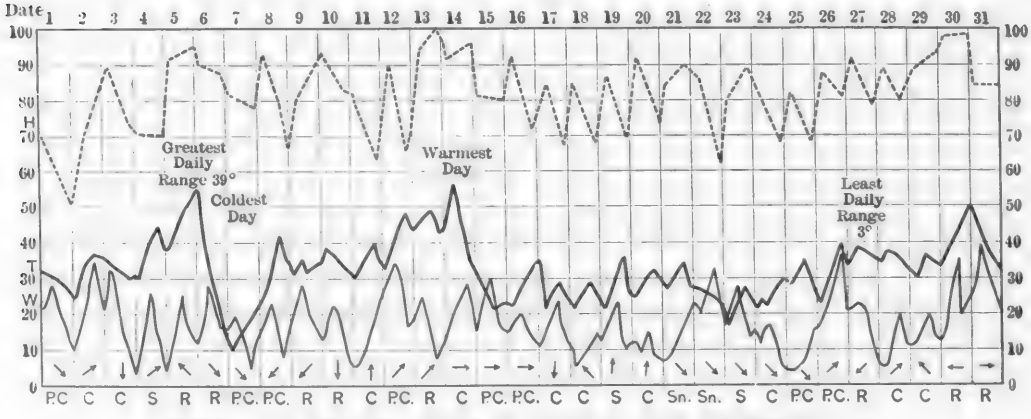
RECORD OF THE WEATHER IN NEW YORK CITY FOR DECEMBER, 1906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Greatest Daily Range 39°
Coldest Day
Warmest Day
Least Daily Range 3°
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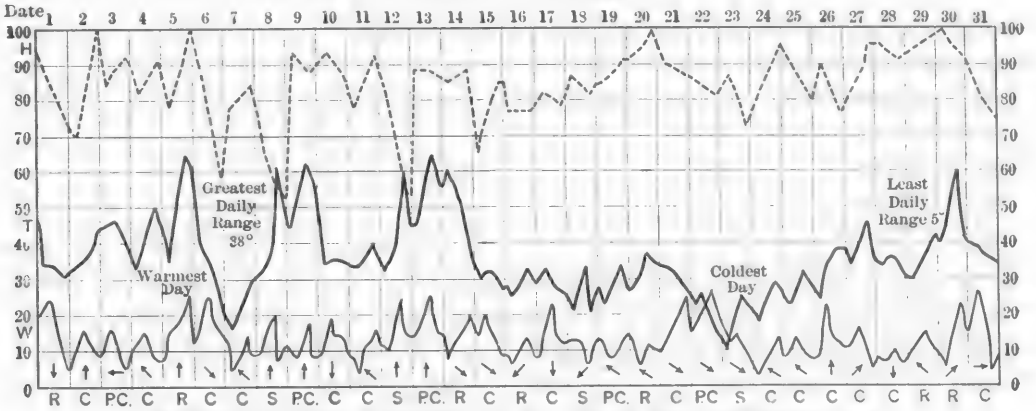
RECORD OF THE WEATHER IN CHICAGO FOR DECEMBER, 1906

Upper black line indicates temperature in degrees Fahr.
Dotted line indicates relative humidity in percentage
Lower black line indicates velocity of wind in miles per hour
Arrows fly with prevailing direction of wind.
S—Clear. PC—Partly Cloudy. C—Cloudy. R—Rain. Sn.—Snow

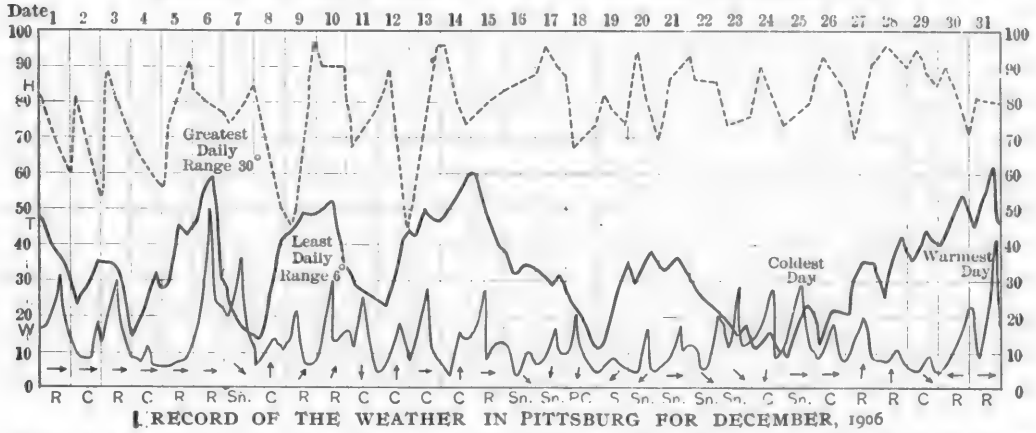
locity for 5 minutes, 52 miles from the west on the 6th. There was 1 clear day, 2 days partly cloudy, 28 cloudy and 21 rainy.

BOSTON

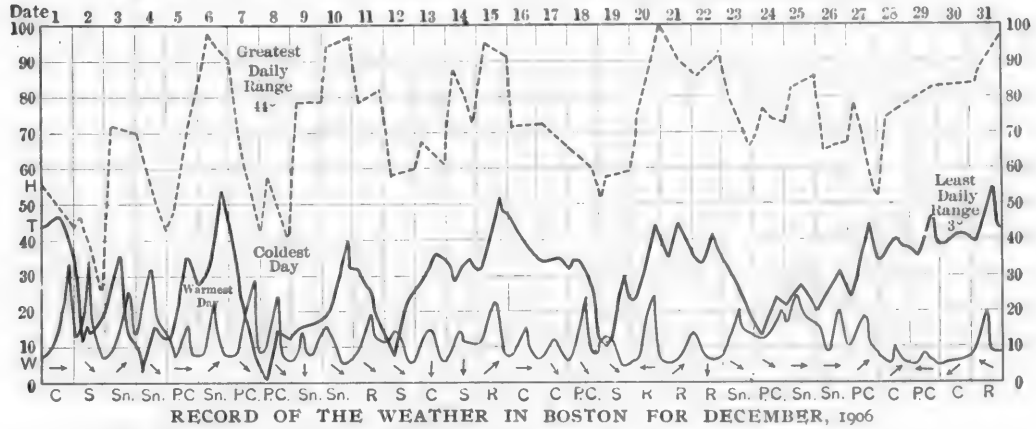
In Boston the highest temperature recorded was 54° on 6th, and the lowest, 1° on the 8th. The greatest daily range was 44° on the 7th and the least daily range, 3° on the 30th. The mean temperature for the month was 29°, which is 2° below the average for 36 years. The total rainfall for the month was 3.95 inches, and the snowfall, 15.5 inches. The greatest rainfall in any one day was 1.67 inches on the 31st. The prevailing direction of the wind was northwest and the total movement, 7,811 miles; average hourly velocity, 10.5 miles; maximum velocity for 5 minutes, 36 miles from the northwest on the 2d. There were 5 clear days, 9 days partly cloudy, 17 cloudy and 15 rainy.



RECORD OF THE WEATHER IN ST. LOUIS FOR DECEMBER, 1906



RECORD OF THE WEATHER IN PITTSBURG FOR DECEMBER, 1906



RECORD OF THE WEATHER IN BOSTON FOR DECEMBER, 1906

Upper black line indicates temperature in degrees Fahr.
Dotted line indicates relative humidity in percentage
Lower black line indicates velocity of wind in miles per hour
Arrows fly with prevailing direction of wind
S—Clear. PC—Partly Cloudy. °C—Cloudy. R—Rain. Sn.—Snow

TRADE AND MISCELLANEOUS NOTES

Deaths.

William Allen, president of the William Allen & Sons Company, boiler manufacturers, Worcester, Mass., died November 27th at the age of 81 years.

Joseph T. Murdock, vice-president of the Murdock Manufacturing & Supply Company, Cincinnati, Ohio, died at his home in that city, January 4th. He was 37 years old.

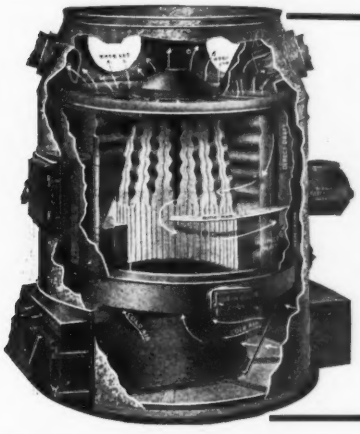
Miscellaneous Notes

Alfred Fowle, Jr., president of the Central Foundry Company, and J. B. Murphy, vice-president of the company, have both resigned.

John T. Sayward Co., New York, have been granted a discharge in bankruptcy. The liabilities amount to $62,168.

Lord Kelvin's views on the advantages of the metric system with opinions of several eminent men, and including, also, explanatory tables comparing the British tables of weights and measures with the metric system, has been received from the Decimal Association of London. The booklet contains 64 pages and contains the opinions of some 88 individuals and representatives of various trades and industries.

Canada's new tariff law, which went into effect November 30th, continues the British preference of one-third the amount of the general tariff, and also gives England an increased preference on ingot and sheet metal. A surtax of one-third on German goods will still be imposed in addition to the general tariff which averages from 25 per cent. to 35 per cent. on manufactured articles. The duty on iron pipe, which was formerly



30,000 KELSEY
Warm Air Generators in Use

SURELY, the Kelsey must give the right kind of results, or this number could not have been sold since 1889 with sales increasing every year.

The Kelsey is not an ordinary furnace; it warms fresh air by the best method, warms large volumes of air properly and forces to distant or exposed rooms.

The Kelsey is economical because it has more than double the weight and heating surfaces of the ordinary furnace with the same size grate, and utilizes the heat to much better advantage.

SEND FOR BOOKLET 20 AND "OPINIONS" AND INVESTIGATE FOR YOURSELF.

Adapted for cottages, palatial residences, churches and schools.

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The Albany Return Steam Traps

have been the STANDARD for over THIRTY-TWO YEARS. For returning water under pressure to the boiler, they will perform this duty fully as well, and in many cases better than the so-called steam loop.

Send for circulars A, B, C and D.

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FREDERICK TOWNSEND, PRESIDENT
JAMES H. BLESSING, GEN. MGR.

15 per cent., has been increased to 35 per cent. The prices on iron pipe have already advanced in proportion to the increased duty.

Manufacturing Notes

National Tube Co., Pittsburg, Pa., is planning to build, at Lorain, Ohio, a 90-foot blast furnace of 450 tons capacity and six open hearth furnaces of 50 or 60 tons capacity. The company will also erect a new galvanizing plant.

Medford Light & Heating Co., Medford, Wis., has increased its capital from $10,000 to $20,000.

Hart & Crouse Co., Utica, N. Y., is building a new office building in order to carry on the increasing business of the company.

Standard Fitting & Valve Co., Guelph, Ont., has bought a site for $5,000, on which it will build a plant for the manufacture of wrought iron and plumbers supplies. The company was recently incorporated for $100,000. The buildings will cost about $30,000 and the machinery $75,000.

Coppridge Heater Corporation, Richmond Va., has increased its capital stock from $25,000 to $50,000, fully paid.

Dominion Radiator Co., Toronto, Ont., is building a new factory on Dufferin street, so that the company can better engage in the manufacture of steam fittings.

Philadelphia Pipe Bending Co., Philadelphia, Pa., has bought the plant of the Philadelphia Pipe Bending Works. The company was recently incorporated for $50,000.

Spang, Chalfant & Co., Etna, Pa., is rebuilding its pipe manufacturing plant. The new buildings will cost about $500,000 and will be equipped throughout with the most modern machinery.

National Radiator Co., Johnstown, Pa., has inaugurated the bonus system of rewarding merit at Christmas time. This year the highest amount given was $67.80 and the lowest seven cents.

Crane Co., Chicago, Ill., as has been their custom for the past seven years, set aside a certain amount of the profits to be distributed among the employees as a Christmas gift. This year, the company gave the equivalant of 10 per cent. of the amount drawn during the year by every employee. The total was $325,000.

N. O. Nelson Mfg. Co., St. Louis, Mo., has received the 1906 bonus. Mr. Nelson has ordered this distributed and writes, from New Orleans, La., that it amounts to $200,000, which came as a Christmas gift to the employees and customers.

Walker & Pratt Mfg. Co., Boston, Mass., is building a new addition to its warehouse at Watertown, Mass., which will be 100x180 feet.

Kennedy Valve Mfg. Co., Elmira, N. Y. is erecting a new valve plant to take the place of the one now at Coxsackie, N. Y. This plant will have a machine shop, 95x300 feet, an iron foundry, 95x308 feet, and a pattern shop and pattern storage building, 50x300 feet.

Post yourself on Vacuum Heating
MORGAN PATENTS
NEW LINE OF CATALOGUES WRITE AT ONCE FOR FULL PARTICULARS AND PRICES
CHICAGO MINNEAPOLIS
Kellogg Mackay-Cameron Co.
SOLE OWNERS
KANSAS CITY SEATTLE

The Proof of Reliable Goods
Is Found in Their Continued and Increased Use

¶ The sales of Norwall Automatic Air Valves are running nearly double those of last year. ¶ The sales of Norwall Automatic Air and Vacuum Valves are running over three times those of last year. ¶ Users of NORWALL VALVES keep on using them. ¶ Enough said—but let us tell you why these facts are true, and show you what these valves will do.

NORWALL MANUFACTURING CO.
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Pierce, Butler & Pierce Mfg. Co., Syracuse, N. Y., at a recent meeting of its stockholders, increased the capitalization from $300,000 preferred and $600,000 common to $300,000 first preferred, $700,000 second preferred and $1,500,000 common stock. The increase in the capital of the company has been made necessary by its largely increased business, the sales having grown from $150,000 in 1882 to $2,000,000 at present. The new stock will be held in the treasury and issued as the expansion of the company increases. The firm is now one of the largest in the world in the manufacture of heating goods, and William K. Pierce, the president and general manager, reported a greatly increased business for the year just ended. The annual salesmen's conference was held in Syracuse, January 3 and 4, at which splendid trade conditions for the coming year were reported. Much time was spent in the factory in going over the latest developments in the company's apparatus. Among those present were: E. C. Molby, eastern manager; E. A. Morris, manager of the Boston office; E. H. Giles, manager of the Philadelphia office; Secretary P. M. Beecher.

Walworth Mfg. Co., Boston, Mass., has been appointed sole agents for the sale of the Genuine Robbins Chain Tong.

New Firms

Gilbert-McCloskey Supply Co., Philadelphia, Pa., is the name of a new firm which will conduct a heating business at 19 North Bennett street. Mr. Gilbert, who is one of the firm, has for several years been connected with the American Radiator Company.

New Incorporations

Jahant Heating Co., Akron, Ohio, has been incorporated with a capital of $30,000. The incorporators are: J. P. Loomis, M. Otis Howard, I. F. Allen and H. F. McGill.

Central Foundry Co., Hamilton, Ont., has been incorporated with a capital of $25,000. The incorporators are: John T. Gardner, W. L. Huber, C. O. Margedant, A. Margedant, and W. C. Margedant.

Manitowoc Equipment Co., Manitowoc, Wis., has been incorporated with a capital of $5,000 to conduct a heating and steamfitting business. Jay Phillips and Frank West are promoters of the new company.

Wm. M. Clancy Plumbing & Heating Co., St. Louis, Mo., has been incorporated with a capital of $5,000. The incorporators are: Wm. M. Clancy, Redmond D. Brennan, John R. Clancy and Regina C. Brennan.

Standard Thermostat Equipment Co., Boston, Mass., has been incorporated with

Thermostatic Regulation

as manufactured
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National Regulator Company

is the most simple and effective of any on the market.
For the proper control of Dampers and Valves in a Heating Apparatus it has NO EQUAL.
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a capital of $100,000. The incorporators are: Jarvis E. Baker, George M. Foster and William E. Ludden.

Fuel Economizer Co., Jamestown, N. Y., has been incorporated with a capital of $5,000 to manufacture a smoke consuming device. The incorporators are: G. A. Wood, F. Bauer and F. J. Hutchinson.

Mohawk Valley Heating Co., Utica, N. Y., has been incorporated with a capital of $6,000 to manufacture heating specialties. The incorporators are: Clarence M. Lyman, John W. Vogel, Irving L. Jones, George E. Camp and Russell Wheeler.

Garner Ventilating Co., Chicago, Ill., has been incorporated with a capital of $10,000 to manufacture and deal in ventilators. The incorporators are: James G. Garner, George T. May, Jr., and Force Bain.

Trenton Heating & Lighting Co., Trenton, Ky., has been incorporated with a capital of $2,000. The incorporators are: W. J. Dickinson, S. D. Chestnut, J. C. Mimms and Ware Brothers.

R. M. Dillon Steam Boiler Works, Fitchburg, Mass., has been incorporated with a capital of $100,000 to deal in steam boilers, flues, etc. The officers are: President, David M. Dillon; treasurer, F. M. Dillon; clerk, D. Frank Dillon.

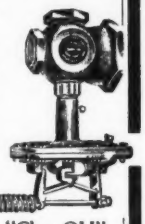
Ross Steam Specialty Co., Brooklyn, N. Y., has been incorporated with a capital of $30,000. The incorporators are: Horace N. Dougherty, Henry T. Gerdes and Adolph H. Stein.

Haverhill Construction Co., Haverhill, Mass., has been incorporated with a capital of $20,000 to do a heating and plumbing business. The officers are: President, Perry E. Elliott; treasurer, Frank A. Rand; clerk, Lewis A. Day.

Elmira Saw & Machine Co., Elmira, N. Y., has been incorporated with a capital

FOR low pressure delivery in steam heating a "Class Q" or "Class QH" Valve is specially adapted.

The "Class QH" Valve is specially intended for vacuum systems and has enlarged outlet connections to permit the use of a valve smaller than the delivery pipe.


"Class QH" Valve

"Class Q" Valve

Send for a Foster Catalog giving full details of these valves as well as Foster "Class W" Valves Free. Exhaust Valves, Float Valves, Pump Governors, etc.

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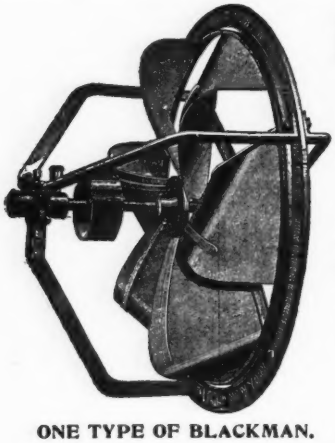
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PUSH OR PULL AIR

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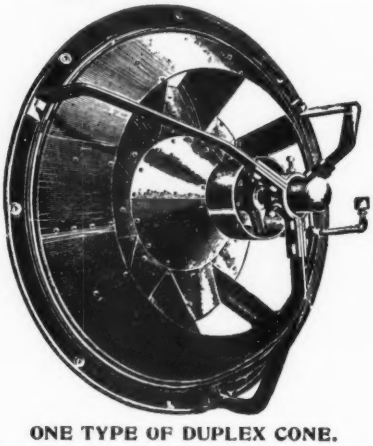
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